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MERAMEC RIVER, MISSOURI COMPREHENSIVE BASIN STUDY. VOLUME VII. --ETC(U)
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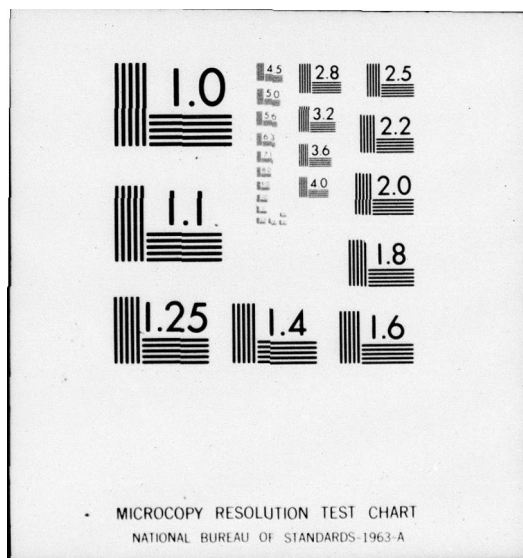
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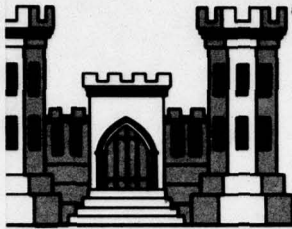
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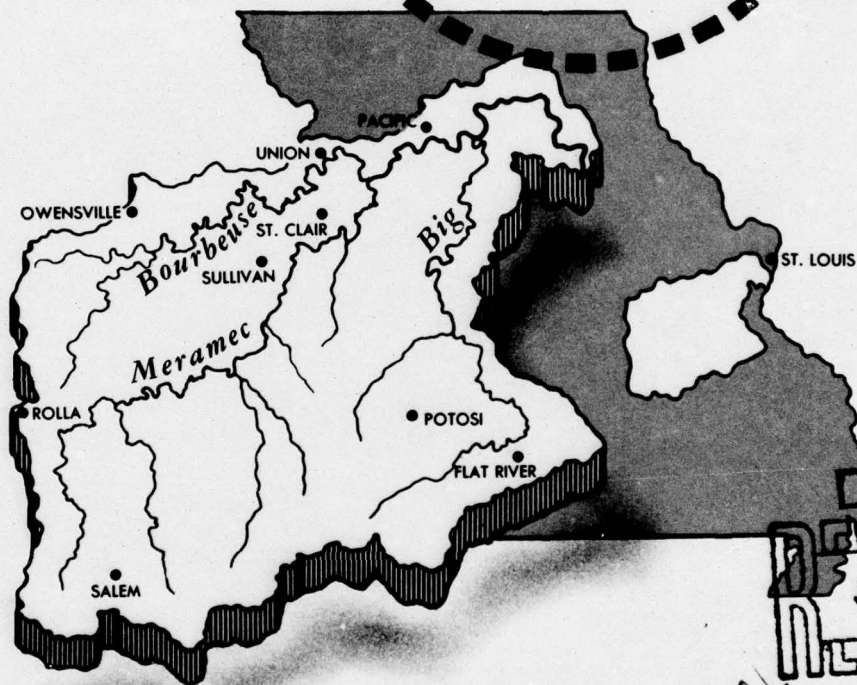




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COMPREHENSIVE BASIN STUDY

VOLUME VII

- APPENDIX M - RECREATION NEEDS RELATED TO RESERVOIRS
- APPENDIX N - MULTIPLE USE SURVEY - CLARK NATIONAL FOREST
- APPENDIX O - EFFECT ON FISH AND WILDLIFE
- APPENDIX P - EFFECT ON CAVES
- APPENDIX Q - FLOOD CONTROL ECONOMICS
- APPENDIX R - EVALUATION OF BENEFITS
- APPENDIX S - DIGEST OF PUBLIC OPINION

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U. S. ARMY ENGINEER DISTRICT, ST LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
JANUARY 1964

①

COMPREHENSIVE REPORT
MERAMEC RIVER BASIN,
MISSOURI

⑥ Meramec River, Missouri Comprehensive
Basin Study. Volume VII,
Appendices M thru S.

⑪ Jan 64

⑫ 289p.

APPENDIX M
RECREATION NEEDS RELATED TO RESERVOIRS

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MERAMEC RIVER, MISSOURI
COMPREHENSIVE BASIN STUDY

APPENDIX M

RECREATION NEEDS
AS RELATED TO RESERVOIR SYSTEM

by

United States
Department of the Interior

National Park Service
Midwest Region
1709 Jackson Street
Omaha 2, Nebraska

Bureau of Outdoor Recreation
Lake Central Region
15 Research Drive
Ann Arbor, Michigan

UNITED STATES
DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE
MIDWEST REGION
1709 Jackson Street
Omaha 2, Nebraska

BUREAU OF OUTDOOR RECREATION
LAKE CENTRAL REGION
15 Research Drive
Ann Arbor, Michigan

June 19, 1963
Revised

Lt. Col. H. B. Barke
Acting District Engineer
St. Louis District
Corps of Engineers
420 Locust Street
St. Louis 2, Missouri

Dear Col. Barke:

This report is in reply to the letter of October 4, 1961 from your office requesting an evaluation of recreation needs in the Meramec River Basin, as related to a Corps of Engineer proposal for 31 reservoirs within the basin.

The report was prepared jointly by the National Park Service, which originally undertook the study, and the Bureau of Outdoor Recreation, which entered the picture somewhat later. Both of our agencies have worked closely in the report's preparation. The National Park Service has prepared the land, development and operation and maintenance costs, based on attendance estimates made by the Bureau of Outdoor Recreation. The Bureau also prepared the benefit estimates.

Although the report is oriented toward the Corps of Engineers proposal, we do not mean to indicate that the reservoirs discussed offer the best method of providing recreation in the basin. Perhaps a more efficient single-purpose plan could be devised to satisfy water recreation needs more fully, and at less cost. A principal feature of such a plan is that it would be people-oriented instead of basin-oriented.

In December of 1961 the research arm of the Meramec Basin Corporation, a privately-financed organization, published a comprehensive, three-volume study of the Meramec Basin. The research project was headed by Dr. Edward L. Ullman, a nationally-known geographer on the staff of the University of Washington, Seattle, Washington,

and the staff included several other geographers and planners. Without endorsing the findings and recommendations included in the report of the Meramec Basin Research Project, we should like to acknowledge the assistance which that report provided. Descriptions of the physiography and economic characteristics of the basin are most complete. Readers interested in finding out more about these subjects are referred to that report.

The Meramec drainage consists of the Meramec River and its two tributaries, the Big River and the Bourbeuse River. The basin extends southwest from St. Louis for about 110 miles. It is approximately 80 miles across at its widest point and drains an area of 3,900 square miles.

The chief recreation resource of the basin is a composite of hilly, rolling terrain covered with oak forests. The streams are, for the most part, entrenched in deep valleys and have narrow flood plains which in places provide fertile soils. Major settlements, including cities and major roads, occur on the ridges.

Some 60 per cent of basin land area is forested with most of the non-forested land occurring in the downstream portions of the basin. Although large blocks of unbroken timber occur in the southern portion of the basin, much of the woodland is of a scrubby nature, having fairly dense underbrush during the summer.

The most comfortable seasons for recreation occur in the Spring during April and May, and in the Fall from September to November. The Summer months of June, July, and August are generally hot and uncomfortable. Because of the relatively mild climate, winter sports are unpredictable and have not been developed.

Tourists on U. S. 66 (Interstate 44) are directed, by numerous signs to two of Missouri's caves: Meramec Caverns and Onondaga Cave. These caverns have been commercially developed and provide an interesting trip. Fisher's Cave in Meramec State Park is smaller and less developed, but also makes an interesting tour. These caves are located in the basin, as is Meramec Spring near St. James, the only spring of first magnitude found in the basin. The Meramec Spring site also marks the location of an early blast furnace.

Water as a recreation resource is available only in streams or rivers. Clearest of the rivers is the Meramec itself and two of its tributaries, Huzzah and Courtois Creeks. The Meramec River from the point where it crosses the western boundary of Crawford County to its junction with the Bourbeuse constitutes a major stream resource in the eastern portion of Missouri. The Big River and its Mineral Fork tributary drain the lead belt, eastern portion of the basin, and are attractive streams. Draining the northern, or agricultural section, of the basin, the Bourbeuse River is more turbid, though still attractive. At one time the upper reaches of all these streams were included within a stream preservation plan formulated by the Missouri Conservation Commission. Due in part to the steep topography along the streams, accessibility has been limited.

All or part of twenty counties are included in the basin or in its zone of recreation influence. The 1960 population considered to be affected by the proposed impoundments includes 1,700,000 persons. Of this number, 78 per cent are classified as urban residents of St. Louis City and its suburbs. In other words, the large majority of potential users live at the basin's north-eastern apex. Travel time from St. Louis to the farthest point in the basin is about three hours. Thus, the recreation resources of the drainage can be used for a day use or week-end excursions.

Other population centers which would be served include Jefferson City, Rolla, and the Flat River-Desloge-Bonne Terre area. Users from these cities also would be urban residents. Rural residents, constituting 16 per cent of the affected population, would, of course, make good use of the lakes.

As of February 1, 1963, nine of the 20 counties had been designated redevelopment areas. Most of these counties lie in the lead belt or in the upstream portions of the basin, and are predominantly rural.

Existing recreation facilities located in or near the Meramec Basin are shown in Table I. Extent of use is indicated by the 1962 attendance figures. Relating to the Corps proposal, the most prominent characteristic of these existing areas is a lack of water surface. Although several of the areas border streams, the only water surface of any size is Lake Alton, formed by water backed up by a navigation dam across the Mississippi River above its confluence with the Missouri. In appearance, the lake

is merely an enlargement of the river. Despite a fairly strong current and somewhat muddy water, the lake does provide a large amount of boating and a limited amount of swimming. Twenty per cent of the shoreline is in public ownership, much of it on the Illinois side. A number of access points have been developed by the Illinois Department of Conservation on the eastern shore. Most of the boating use is from private marinas. It can be said that a great deal of use is given the lake, but satisfies only a small fraction of the demand. Private summer cottages, many on stilts, ring the lake. The same is true along some reaches of the lower Meramec River.

Commercial resorts in or near the basin are small in number. The older resorts are located along the major streams, primarily for fishing and swimming. In the newer resorts, swimming pools are replacing stream swimming.

Boating opportunities are limited, being centered, for the most part, on the Mississippi River or Lake Alton.

Estimating recreation demand is very difficult, since the demand tends to increase as facilities are provided. At the present time, virtually no water surface is available. If and when a series of lakes is constructed, a great deal of use certainly will materialize. The estimates herein provided are based on observations at other impoundments, and are made with the assumption that the demand for recreation water in this region is almost explosive. For example, near Kansas City a 900 acre lake was available for use in 1960. By 1962 attendance had increased to 1,666,848 users. Since a two-county population surrounding the lake was 652,434 persons in 1960, the potential demand is apparent. Use appears to be limited only by physical developments. A similar situation is believed to exist in the St. Louis region.

The cost and attendance estimates given in Table II are interrelated. In some cases, as at Meramec Park Reservoir, full development is contemplated, perhaps even reaching development characteristic of urban parks. At the more remote impoundments and some smaller ones nearer St. Louis, a more rustic facility is visualized. If only one or two reservoirs in the vicinity of St. Louis were being planned for, one could assume that full development would receive full use. However, when as many as 31 lakes are planned, a more satisfying, dispersed type of recreation can be provided.

In addition to extent of development, distance from population centers has weighed heavily as a factor influencing use. The matter of distance is discussed in some detail in the report of the Meramec Basin Research Project, and holds that, as distance from users increases, recreation use decreases rapidly. We have generally followed this hypothesis in making use estimates.

The cost of additional land needed for recreation is not included in the development cost. In fact, the figures supplied in this report must be considered tentative, although they probably do represent maximum additional land required. The land estimates given here originated with the National Park Service and were subsequently computed by the Corps of Engineers to eliminate land which would be acquired in accordance with the latest land acquisition policy. It is our understanding that the Corps will acquire land for project purposes 300 feet horizontally from the top of the flood storage pool or the top of the surcharge pool, whichever is greater. If this policy is altered, the recreation land estimates will have to be revised. We emphasize that these land estimates will have to be refined by more sophisticated on-site surveys.

Annual operation and maintenance estimates are based on twenty-cents per visitor day, which rate compares with maintenance costs in a number of states and with estimates currently being made in other reports.

The priority assigned represents a schedule of construction that could be followed to provide equal distribution of recreation opportunities for residents in all parts of the basin without extensive travel distances, during various stages of development. The reservoirs assigned priorities 24 through 31 are those considered to be unjustified for recreation alone, if all other reservoirs are constructed. It is considered that the other reservoirs will provide sufficient resource to fulfill needs in the regions affected.

The level of significance of most of the reservoirs, from the recreation standpoint, is considered to be local. One exception is Meramec Park Reservoir which, if developed as contemplated, may be of state significance. The landscape of this site is more outstanding than is that of the other sites and possesses greater potential for outstanding development. State administration should be explored at this site. Within the Clark National Forest

five reservoirs are proposed. It is our recommendation that the Forest Service administer recreation at these lakes and that, so far as possible, recreation lands be acquired to complement present National Forest properties. The National Forest ownership is such that blocking in of lands between the reservoir take-line (300 feet from top of the flood control pool) to the present Forest Service boundaries, which generally follow valley ridgetops, seems most desirable. In the case of the remaining impoundments, local governments should be encouraged to assume responsibility for administering recreation.

A number of special considerations exist which deserve additional discussion:

1. Benefits assigned are contingent upon development to the extent of \$23,600,000. It is our feeling that not all of these costs should be borne by the Federal Government, but that state and local agencies should contribute to provide recreation facilities which, in fact, will meet primarily local needs. We know that your staff shares this view and may propose a specific formula for sharing costs. For those reservoirs selected for construction, however, the share suggested for local participation should not be so great as to be impossible of achievement. Land costs should in all cases be a Federal expense and sufficient funds should be made available to provide basin facilities needed for public comfort and safety. The extent of Federal participation is yet to be negotiated. Unless some assurance can be given that the state or local governments will assume a share of assigned costs, benefits will have to be down-graded accordingly, since the contemplated full development will not materialize. Benefits should be assigned only on the basis of reasonable expectation of achievement.

2. Attendance estimates and benefits are assigned for 1970, assuming the projects will have been built three years, a relatively short period of time. The year 1970 is, itself, somewhat unrealistic and we would have preferred to work with 1975. Developments resulting from initial construction would last approximately 25 years, after which time additional funds will have to be spent for replacement and rehabilitation. We realize that the Corps would have preferred projections for attendance, replacement cost and annual operation and maintenance cost for a 100 year period. As we worked on this matter, it became apparent that such projections are not reasonable to compute. Techniques have not been refined sufficiently to provide meaningful data over that long time span. Projections

to 2000 were made for attendance, based on the finding of the Outdoor Recreation Resource Review Commission that participation in outdoor pursuits will triple by that year, and even these projections appeared unsupportable. As an alternate course, we recommend that your staff project needed estimates over the 100 year period, in conjunction with the projection of other factors also being considered. We have consulted with your staff on methods to be employed and feel that such projections will be as realistic as others which might be made.

3. The construction of reservoirs in the Meramec Basin will provide an outstanding recreation resource of a type not existing at present. At the same time, large impoundments will modify another recreation resource, the free-flowing stream. As free-flowing streams, none of the waterways involved in this project are believed to be of national significance. Although we have detected little opposition in the State of Missouri to impounding these streams under the 31-reservoir plan, we wish to make it clear that the outstanding free-flowing streams in the basin, particularly the Huzzah and Courtois Creeks, at the upper reaches of Meramec Park Reservoir, will be affected. In the downstream portion of the Huzzah, six miles of the creek will be inundated by the normal pool, and six miles intermittently by the flood pool. In the downstream portion of the Courtois, five miles will be flooded by the normal pool, and two and a half miles by the flood pool. These comments do not constitute an adverse report on the part of our agencies.

4. Two of the State's principal tourist attractions, Onondaga Cave and Meramec Caverns, will be partially affected by Meramec Park and Virginia Mines Reservoirs, respectively. Neither of these caves possesses national significance. The State has been alerted to possible damage to the caves, but as yet, has expressed no concern. It is recommended that the Corps include a statement in the recreation appendix, describing the effects of the reservoirs on the caves. This observation does not constitute an adverse report by our agencies.

5. A pump back storage reservoir for power generation is planned at Meramec Park Reservoir. Power production will cause a daily fluctuation of half a foot in the main reservoir but will not affect recreation. Fluctuation of the pump back 272 acre hilltop reservoir will be 27 feet, an amount too great to permit any recreation use. This reservoir should be fenced. We have been

advised informally that pump back provision for power generation also may be provided at Salem and Pine Ford Reservoirs, in connection with which the two reservoirs may fluctuate as much as two feet daily. Although no adjustments in attendance benefits will be made due to this fluctuation, variation in excess of two feet would adversely affect recreation as a major benefit.

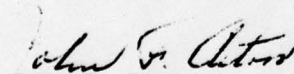
6. Swimming is a recreation activity growing in popularity. In the Meramec basin, few swimming opportunities exist. The construction of these reservoirs should do much to alleviate this shortage, and, wherever possible, swimming opportunities should be provided. If swimming within the reservoirs is not practical, due to inaccessibility or water quality control problems, it is recommended that special swimming areas be considered for construction below the dams. These areas would be controlled pools, adaptable for chlorination, if necessary. Location below the dam would allow for easy access, since sufficient level land would be available for parking and public use facilities.

7. The Bureau of Sport Fisheries and Wildlife has recommended multiple level outlets for some of the dams. We concur in this recommendation and urge its adoption.

Again, we point out that the estimates and observations herein are based on brief field investigations and conferences with members of the St. Louis District planning staff. Further study and more detailed field investigations may necessitate changes.

Sincerely yours,

Sincerely yours,


John F. Aiton
Acting Assistant Regional Director
National Park Service



Evan A. Haynes
Field Representative
Bureau of Outdoor Recreation

TABLE I

Major Recreation Areas In or Near
Zone of Influence of the
Meramec Basin Reservoirs

	Attendance 1962	Acreage		Significant Features			Type of Use			Activities						
		Total Land and Water Within Area	Water Surface	Lake (1)	Reservoir (1)	River	Forest	Mountains	Biological	His. or Arch.	Geological	Day and Weekend	Vacation	Out-of-state	Target	Tourist Enroute
Parks																
Cuivre River State Park	384,990	5,822	85		x	x	x		x	x	x	x	x	x	x	x
Meramec State Park	592,624	7,153				x	x		x	x	x	x	x	x	x	x
Montauk State Park	176,485	7,846				x	x		x	x	x	x	x	x	x	x
Johnson Shut-ins State Park	133,788	2,478				x	x		x	x	x	x	x	x	x	x
Washington State Park	154,899	1,101				x	x		x	x	x	x	x	x	x	x
Hawn Tract (State Park)	-	2,258				x	x		x	x	x	x	x	x	x	x
Creve Coeur Lake Memorial Park	-	420	50	A								x				
Wildlife Areas																
Indian Trail Forest and Refuge	3,000	13,253				x						x				
August A. Busch Wildlife Area	75,000	7,000	250		x							x				
Forests																
Clark National Forest	200,000	200,000				x						x				
Huzzah State Forest	11,000	6,078				x						x				
Daniel Boone Memorial Forest	4,500	2,250				x						x				

(1) An "A" indicates water surface acreage is adjacent to area.
An "x" indicates water acreage is within boundary

	Attendance 1962	Acreage		Significant Features												Type of Use				Activities							
		Total land and Water	Water Surface	Lake (1)	Reservoir (1)	River	Forest	Prairie	Mountains	Biological	His. or Arch.	Geological	Day and Weekend	Vacation	Out-of-state	Target	Tourist Enroute	Picnicking	Hiking & Riding	Camping	Boating	Swimming	Fishing	Hunting	Nature Study		
Private, Open to Public																											
Gray Summit Arboretum	-	1,675																									
Maramec Spring Recreation Area	215,405	1,700																									
Edmund A. Babler State Park	176,376	2,400																									
Nature Preserves																											
Rockwoods Reservation	300,000	1,785																									
Miscellaneous																											
Lake Alton	2,761,000		22,000																								

TABLE II

Meramec River Basin, Missouri
General Recreation Attendance, Benefits, Lands,
Recreation Development and Maintenance Costs

Priority	Reservoir	Visitor-day Attendance 1970 1/	Benefits 1970 1/	Development Costs 2/	Recreation Land Acres 3/	AO&M @ .20 per Visitor-day 2/
1	17 Meramec Park 4/	3,013,600	\$ 4,821,760	\$10,500,000	9,400	\$ 602,720
2	2A Pine Ford 4/	1,900,000	3,040,000	3,000,000	4,600 7/	380,000
3	27 Salem 4/	500,000	800,000	1,150,000	2,600	100,000
4	9 Irondale 4/	590,000	944,000	1,200,000	1,850	118,000
5	I-38 4/	250,000	400,000	625,000	1,300	50,000
6	I-14 5/	54,000	86,400	75,000	2,400 8/	10,800
7	40 Virginia Mines	2,000,000	3,200,000	2,500,000	5,100	400,000
8	I-23	200,000	320,000	315,000	1,200	40,000
9	5 Washington Park	300,000	480,000	300,000	1,100	60,000
10	I-15A 5/	70,000	112,000	100,000	1,860 8/	14,000
11	H-40	55,000	88,000	50,000	840	11,000
12	I-32	112,000	179,200	110,000	540	22,400
13	29 Union	1,500,000	2,400,000	2,500,000	3,500	300,000
14	I-30	100,000	160,000	100,000	450	20,000
15	I-28	200,000	320,000	300,000	1,600	40,000
16	H-6	65,000	104,000	75,000	660	13,000
17	I-26 5/	61,000	97,600	70,000	1,520 8/	12,200
18	H-8	60,000	96,000	70,000	850	12,000
19	H-13	50,000	80,000	60,000	740	10,000
20	H-4	20,000	32,000	35,000	440	10,000 9/
21	H-9	15,000	24,000	25,000	340	10,000 9/
22	H-25 5/	10,000	16,000	20,000	1,050 8/	10,000 9/
23	H-10 5/	4,000	6,400	20,000	290 8/	10,000 9/
24	I-33A 6/	70,000	105,000	100,000	1,030	14,000
25	I-35A 6/	70,000	105,000	100,000	1,070	14,000
26	H-11 6/	40,000	60,000	50,000	450	10,000 9/
27	H-3 6/	35,000	52,500	50,000	400	10,000 9/
28	H-5 6/	20,000	30,000	35,000	300	10,000 9/
29	I-21 6/	18,000	27,000	35,000	340	10,000 9/
30	I-41 6/	10,000	15,000	20,000	360	10,000 9/
31	H-31 6/	5,000	7,500	20,000	320	10,000 9/
		<u>11,397,600</u>	<u>\$18,209,360 10/</u>	<u>\$23,610,000</u>	<u>48,500</u>	<u>\$2,344,120</u>

(Footnotes on next page).

Footnotes.

- 1/ Prepared by Bureau of Outdoor Recreation
- 2/ Prepared by National Park Service
- 3/ Prepared by National Park Service as computed by
Corps of Engineers
- 4/ Recommended for construction during first 15 years
- 5/ Located on Clark National Forest
- 6/ Considered unjustified for recreation alone, if all
other reservoirs are constructed; however, they
will undoubtedly receive use if built.
- 7/ Includes 750 acres requested by Missouri State Park Board
- 8/ Required by U. S. Forest Service
- 9/ An arbitrary amount of \$10,000 assigned where attendance
is estimated 50,000 or below
- 10/ Benefits assigned at \$1.60 per visitor-day for reservoirs
priority Nos. 1 through 23; at \$1.50 per visitor-day
for Nos. 24 through 31.

COMPREHENSIVE REPORT

**MERAMEC RIVER BASIN,
MISSOURI**

APPENDIX N

MULTIPLE USE SURVEY

MULTIPLE USE SURVEY

Report on
MERAMEC RIVER BASIN
Clark National Forest



FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

UNITED STATES DEPARTMENT OF AGRICULTURE
ANALYSIS OF
IMPACTS UPON THE ADMINISTRATION, MANAGEMENT, AND USE
OF THE
CLARK NATIONAL FOREST AND UPON FOREST RESOURCES

MERAMEC PARTICIPATING PROJECT
MERAMEC RIVER BASIN PROJECT
MISSOURI

IN COOPERATION WITH
CORPS OF ENGINEERS
UNITED STATES DEPARTMENT OF THE ARMY

REPORT PREPARED BY:
CLARK NATIONAL FOREST
NORTH CENTRAL REGION - U. S. FOREST SERVICE
MILWAUKEE, WISCONSIN

FEBRUARY 1963
REVISED DECEMBER 1963

SUBMITTED: C. L. HARRISON
FOREST SUPERVISOR
CLARK NATIONAL FOREST

APPROVED: GEORGE S. JAMES
REGIONAL FORESTER

By George Brown
ACTING REGIONAL FORESTER

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RELATION OF PROPOSED DEVELOPMENT OF MERAMEC RIVER
BASIN MISSOURI, TO THE MANAGEMENT, PROTECTION AND
USE OF THE CLARK NATIONAL FOREST AND ON INTERMINGLED
OR CLOSELY ASSOCIATED NON-FEDERAL FOREST RESOURCES.

INTRODUCTION

THIS REPORT CONSIDERS THE IMPACT OF THE PROPOSED MERAMEC BASIN PROJECT ON THE CLARK NATIONAL FOREST. IT ALSO INCLUDES, IN BRIEF, THE PROJECT IMPACT ON NON-FEDERAL LANDS. THE REPORT DESCRIBES THE FACILITIES, SERVICES, RESOURCES AND USES THAT WILL BE AFFECTED.

DESCRIPTION OF THE PROJECT

THE CORPS OF ENGINEERS, ST. LOUIS DISTRICT, HAS BEEN ASSIGNED OVERALL LEADERSHIP RESPONSIBILITY FOR THE PREPARATION OF A COMPREHENSIVE PLAN OF DEVELOPMENT FOR THE MERAMEC RIVER BASIN IN MISSOURI. IN LINE WITH PROVISIONS OF SENATE DOCUMENT 97 AND THE MULTIPLE USE SUSTAINED YIELD ACT OF 1960, THE FOREST SERVICE HAS THE RESPONSIBILITY (1) TO ASSURE ADEQUATE EVALUATION OF ALL ANTICIPATED IMPACTS ON NATIONAL FOREST DEVELOPMENT AND ADMINISTRATIVE PROGRAMS ASSOCIATED WITH THE WATER RESOURCE DEVELOPMENT PROGRAM AND, (2) TO ASSURE RECOGNITION AND INCORPORATION INTO THE COMPREHENSIVE DEVELOPMENT PLAN, THE FULL POTENTIAL FOR RELATED LAND RESOURCE DEVELOPMENT, BOTH PUBLIC AND PRIVATE.

THE MERAMEC RIVER BASIN EXTENDS ABOUT 100 MILES SOUTH AND WEST FROM ST. LOUIS BETWEEN THE MISSOURI AND MISSISSIPPI RIVERS. THE TOTAL LAND AREA IS 3,980 SQUARE MILES, OF WHICH 619 SQUARE MILES ARE IN THE CLARK NATIONAL FOREST. MAP - PAGE 42.

NINE MAJOR RESERVOIRS HAVE BEEN SELECTED FOR CONSIDERATION IN THE RESERVOIR COMPLEX. ONE OF THE KEY RESERVOIRS IN THE SYSTEM IS THE MERAMEC PARK RESERVOIR. THE UPPER END OF THE NORMAL POOL OF THIS RESERVOIR EXTENDS INTO THE NATIONAL FOREST FLOODING APPROXIMATELY 140 ACRES IN THE NORMAL POOL, AND THE FLOOD CONTROL POOL EXTENDS UP HUZDAH AND COURTOIS CREEKS FIVE AND SIX MILES RESPECTIVELY, FLOODING 2,382 ACRES* IN HUZDAH CREEK AND 1,208 ACRES* IN COURTOIS CREEK.

OTHER PROJECT DEVELOPMENTS INCLUDE 25 HEADWATER IMPOUNDMENTS, OF WHICH FIVE ARE LOCATED WITHIN THE CLARK NATIONAL FOREST. THE RESERVOIRS WHICH HAVE A FLOOD CONTROL STORAGE OF MORE THAN 5,000 ACRE-FEET ARE TO BE FURTHER INVESTIGATED BY THE CORPS OF ENGINEERS, AND THE HEADWATER RESERVOIRS CONTAINING A LESSER AMOUNT WILL BE INVESTIGATED BY THE U.S. SOIL CONSERVATION SERVICE. MAP - PAGE 42.

THE PLAN OF DEVELOPMENT FOR THE BASIN CONSIDERS ALL WATER AND RELATED LAND RESOURCES. CONSIDERATION WILL BE GIVEN TO FLOOD CONTROL; HYDRO-ELECTRIC POWER DEVELOPMENT; INDUSTRIAL, AGRICULTURAL, AND DOMESTIC WATER SUPPLY; INCREASING LOW STREAM FLOWS; ABATEMENT OF STREAM

*INCLUDES 300' PUBLIC ACCESS.

POLLUTION; PROVISION FOR POOLS AND RESERVOIRS FOR FISH AND WILDLIFE CONSERVATION, AND FOR RECREATION.

THE SYSTEM OF RESERVOIRS UNDER STUDY WOULD CONTROL RUNOFF FROM 83 PERCENT OF THE DRAINAGE AREA OF THE BASIN. OUTFLOW WOULD BE CONTROLLED WITHIN BANK CAPACITIES BELOW DAMS. THERE WILL BE AN UNCONTROLLED INFLOW FROM 17 PERCENT OF THE AREA WHICH WILL ADD TO THE RESERVOIR RELEASES.

SCOPE OF CLARK NATIONAL FOREST INTEREST

IMPACTS OF CONSTRUCTION AND OPERATION WITHIN THE NATIONAL FOREST ON NATIONAL FOREST AND NON-FEDERAL LANDS WILL BE CONFINED TO FIVE RESERVOIRS WITHIN THE FOREST AND TO THE THREE MAJOR RESERVOIRS: SALEM, IRONDALE AND MERAMEC PARK RESERVOIRS, WHICH ARE ADJACENT TO THE NATIONAL FOREST. THE AREA OF DIRECT IMPACT WILL BE GREATEST ON PERIMETER LANDS OF THE RESERVOIRS, HOWEVER, IT WILL EXTEND TO ALL LANDS IN THE CLARK NATIONAL FOREST WITHIN THE MERAMEC BASIN. THE BALANCE OF THIS REPORT IS CONFINED TO THE ABOVE LISTED RESERVOIRS SINCE NATIONAL FOREST LANDS AND PROGRAMS WILL BE DIRECTLY AFFECTED BY THEIR INSTALLATION. MAP - PAGE 41.

PROJECT WATERSHED

THE PROJECT WATERSHED OF MERAMEC BASIN OF 3,980 SQUARE MILES INCLUDES 619 SQUARE MILES OF THE CLARK NATIONAL FOREST. THIS INCLUDES ALL OF THE POTOSI RANGER DISTRICT AND PART OF THE SALEM AND CENTERVILLE DISTRICTS. APPROXIMATELY 299 SQUARE MILES (48%) ARE NATIONAL FOREST LAND, AND 320 SQUARE MILES (52%) ARE PRIVATE LAND. (SEE LANDOWNER-SHIP PATTERN ON GENERAL MAP.) PAGE 41.

THE NATIONAL FOREST AREA OF THE BASIN IS PREDOMINANTLY FORESTED. NATIONAL FOREST LANDS ARE 96.6% FORESTED AND 3.4% ROCK, BRUSH, WATER AND FIELDS. EXACT DATA IS NOT AVAILABLE FOR PRIVATE LANDS WITHIN THE FOREST, BUT BASED ON THE COUNTY AVERAGES, 70% OF THE PRIVATE LANDS ARE IN FORESTS, 13% CROPLAND, 13% PASTURE, AND 4% OTHER.

ALL OF THE NATIONAL FOREST WITHIN THE BASIN IS CONSIDERED IN THE IMPACT AREA OF THE BASIN PROJECT. THE MANNER OF MANAGEMENT AND CONDITION IN WHICH THE WATERSHED IS MAINTAINED WILL AFFECT THE LIFE OF THE MERAMEC BASIN PROJECTS REGARDLESS OF OWNERSHIP.

PRESENT STATUS OF AFFECTED AREA

EXISTING FACILITIES

FOREST SERVICE FACILITIES WHICH WILL BE FLOODED INCLUDE 8.5 MILES OF FOREST SERVICE ROADS, OF WHICH 7 MILES WILL BE MADE UNUSABLE, AND $1\frac{1}{2}$ MILES WILL BE SUBJECT TO FLOODING ONLY BY FLOOD CONTROL POOL.

NINE PUBLIC LAND SURVEY CORNERS WILL BE FLOODED BY NORMAL POOL AND 16 MORE WILL BE IN THE FLOOD CONTROL POOL. THERE ARE 101 FOREST SERVICE PROPERTY LINES ADJOINING PRIVATE LANDS WHICH WILL INTERSECT THE RESERVOIR. IN MOST CASES, THESE PROPERTY LINES HAVE NOT BEEN LEGALLY ESTABLISHED, BUT ARE ONLY THE RECOGNIZED PROPERTY LINES. LAND VALUES IN THE PAST HAVE NOT WARRANTED THE COSTS OF LEGAL SURVEY.

CURRENT USE

NATIONAL FOREST LANDS IN THE AFFECTED AREA ARE MANAGED FOR MULTIPLE USE MANAGEMENT WHICH INCLUDES TIMBER, FORAGE, WATER, RECREATION AND WILDLIFE RESOURCES.

TIMBER RESOURCE

THE TIMBER MANAGEMENT PLANS PROVIDE FOR HARVEST OF THE MERCHANTABLE AND MATURE TIMBER THROUGH A CONTINUING SALES PROGRAM. THE CURRENT CUTTING CYCLE IS 1962 TO 1971. SOUND TIMBER MANAGEMENT IN THIS AREA IS ONE OF BUILDING UP THE GROWING STOCK TO A LEVEL WHICH WILL PROVIDE FOR SUSTAINED HARVEST. CURRENT ANNUAL ALLOWABLE CUT IS 7,580 MBM. THERE ARE 55 ACTIVE TIMBER SALES OPERATING IN ACCORDANCE WITH THE APPROVED TIMBER MANAGEMENT PLAN AT THIS TIME.

SAWTIMBER IS THE PRIMARY PRODUCT HARVESTED. A LIMITED MARKET EXISTS FOR HARDWOOD CORDWOOD FOR CHARCOAL. HOWEVER, THIS MARKET IS INSIGNIFICANT IN RELATION TO THE AMOUNT REQUIRED FOR ADEQUATE MANAGEMENT OF HARDWOOD STANDS.

PRESENTLY, AN INDEPENDENT STUDY (EBASCO) IS UNDERWAY TO DETERMINE THE FEASIBILITY OF A PULP AND PAPER MILL. TWO POTENTIAL SITES HAVE BEEN CONSIDERED, ONE NEAR FLAT RIVER, MISSOURI, AND ANOTHER NEAR LEEPER, MISSOURI. A MAP (PAGE 59) SHOWING THE AREA WITHIN A 50-MILE HAULING RADIUS TO EACH OF THE MILLS IS IN THE APPENDIX; ALSO AN ESTIMATE OF PULPWOOD WITHIN THE RESPECTIVE AREAS. PAGES 57 AND 58.

FOR THE MOST PART, PRIVATE TIMBER LANDS ARE NOT MANAGED FOR TIMBER PRODUCTION. THE OWNERS LIQUIDATE THEIR INVESTMENTS AS SOON AS THE TIMBER REACHES MERCHANTABILITY FOR ANY MARKET. THE FEW OWNERS WHO ARE PRACTICING FORESTRY DO SO UNDER STATE SUPERVISION AS PROVIDED BY FOREST CROPLAND LAWS.

RECREATION RESOURCE

RECREATION USE IN THE AFFECTED AREA IS MODERATE. GENERAL ENJOYMENT,



HUZZAH CREEK

BANK EROSION ON HUZZAH CREEK SERIOUSLY THREATENS
DAVISVILLE CAMP AND PICNIC AREA. INDICATES NEED OF
WATERSHED MANAGEMENT PRACTICES ON TRIBUTARY LANDS.

SIGHTSEEING, HUNTING AND PICNICKING TOP THE LIST OF VISITS. A TOTAL OF 238,000 VISITORS WERE REPORTED TO HAVE USED THE AREA FOR RECREATION IN 1961.

THE DAVISVILLE CAMP AND PICNIC GROUNDS ON HUIZZAH CREEK IS THE MOST POPULAR AREA PRESENTLY IN USE ON THE NATIONAL FOREST LANDS. THE PART OF THIS CAMPGROUND WHICH IS NEAREST TO THE CREEK IS SUBJECT TO FLOODING. DURING FLOOD PERIODS, CONSIDERABLE DAMAGE OCCURS TO THE CREEK BANKS, AND GRADUALLY THE STREAM IS CHANGING ITS COURSE. UNLESS PROTECTIVE MEASURES ARE MADE TO THE STREAM BANKS, THIS POPULAR AREA MAY BE DESTROYED THROUGH CHANNEL CHANGES. PHOTO - PAGE 4.

OTHER SITES INCLUDE SHIRLEY PICNIC GROUND WHICH IS ALONG HIGHWAY 8 AND IS USED PRIMARILY AS A ROADSIDE PARK, AND HAZEL CREEK CAMP WHICH IS PRIMARILY A PICNIC SITE FOR LOCAL PEOPLE.

FISH AND WILDLIFE RESOURCE

THE COURTOIS AND HUIZZAH CREEKS ARE THE MAIN FISHING STREAMS. THESE STREAMS, ON THE LOWER REACHES, ARE AMONG THE MORE HEAVILY FISHED STREAMS IN THE OZARKS. PUBLIC ACCESS TO THESE STREAMS IS VERY LIMITED.

UPLAND GAME POPULATIONS HAVE BEEN ON THE INCREASE SINCE THE NATIONAL FORESTS WERE ESTABLISHED. THIS IS ATTRIBUTED TO THE HABITAT IMPROVEMENT COORDINATED IN THE TIMBER SALES AND TIMBER STAND IMPROVEMENT PROGRAMS, AND TO FIRE PROTECTION AND GRAZING REDUCTIONS. ALSO, THE EFFECTIVE REGULATION AND PROTECTION AFFORDED WILDLIFE BY THE MISSOURI CONSERVATION COMMISSION HAS BEEN VERY IMPORTANT.

THE NATIONAL FORESTS ARE THE LARGEST PUBLIC HUNTING AREA IN THE STATE. THE WILDLIFE RESOURCE ON THESE PUBLIC LANDS NOT ONLY SERVES THE HUNTER, BUT ALSO PROVIDES SIGHTSEERS WITH CONSIDERABLE PLEASURE. IT IS NOT UNUSUAL TO SEE DEER OR TURKEY WHILE TRAVELING ON THE LESSER USED FOREST ROADS.

IN 1958, THROUGH COOPERATION OF LOCAL CONSERVATION AGENTS, AN INFORMAL STUDY WAS MADE ON THE LOCATION OF DEER KILLED IN WASHINGTON COUNTY. SINCE EACH HUNTER WAS QUERIED PERSONALLY, IT IS FELT THAT THE RESULTS WERE INDICATIVE OF THE ACTUAL SITUATION. EIGHTY-SEVEN PERCENT OF THE KILL WAS IN THE NATIONAL FOREST, WHICH COMPRISES ONLY 30% OF THE AREA HUNTED. THIS INFORMAL STUDY INDICATES THE IMPORTANCE OF THE NATIONAL FOREST AS A PUBLIC HUNTING AREA.

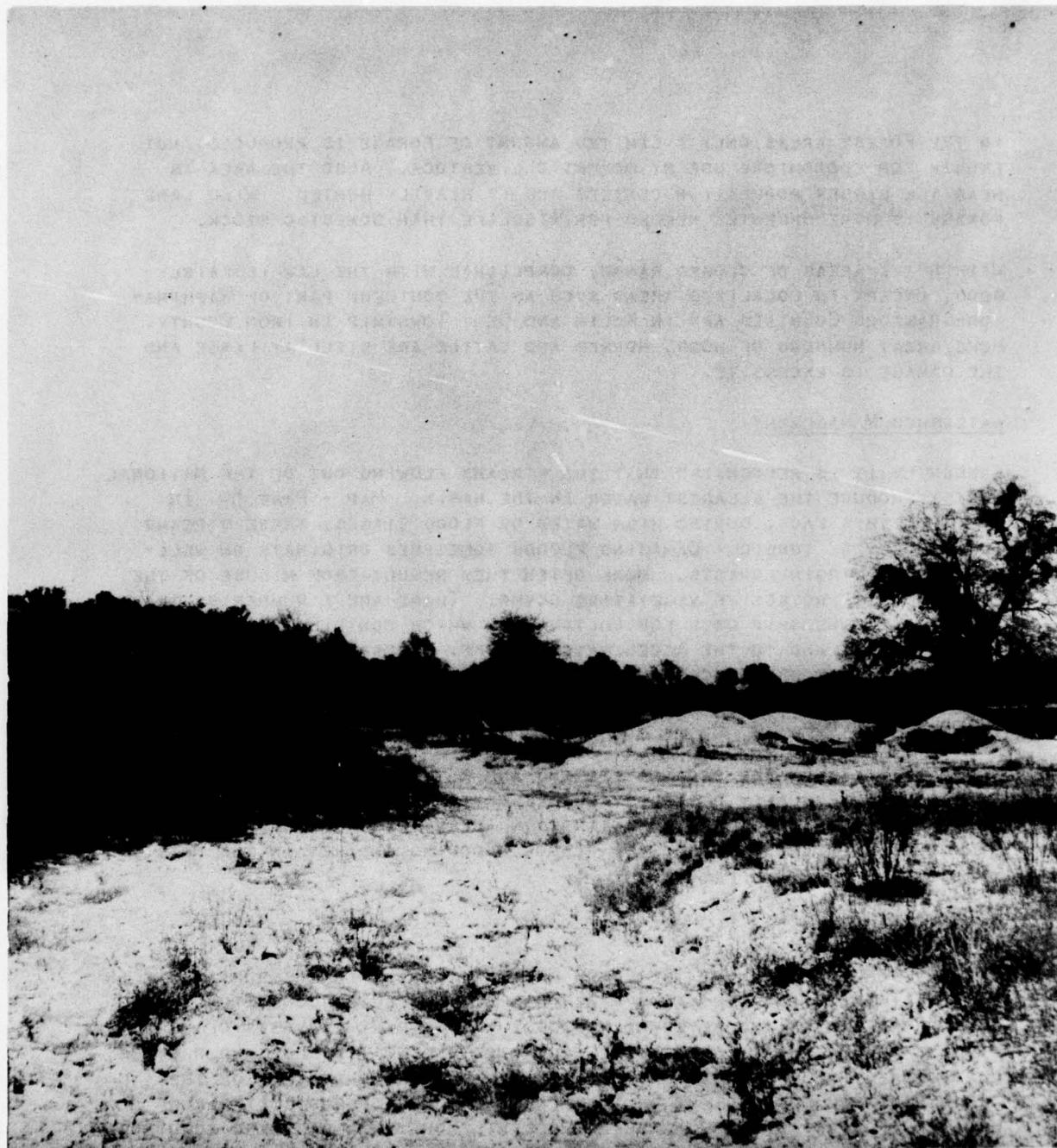
GRAZING RESOURCE

AT ONE TIME THE ENTIRE BASIN AREA OF THE CLARK NATIONAL FOREST WAS GRAZED UNDER "OPEN RANGE" LAW. SINCE 1950, TWO-THIRDS OF THE AREA HAS BEEN CLOSED THROUGH LOCAL LEGISLATION. (SEE OPEN RANGE MAP.)
PAGE 55.



UPLAND EROSION NEAR 1-14.

EXCESSIVE RUNOFF FROM HEAVILY GRAZED PASTURES CREATES
GULLIES AND ADDS HEAVY DEPOSITS OF SEDIMENT TO STREAM
CHANNELS.



STREAM CHANNEL EROSION
UPPER MERAMEC RIVER

GRAVEL PILES ARE FROM CHANNEL REPAIRS MADE TO PROTECT ADJOINING FARM LANDS. ERODED BANKS AND GRAVEL DEPOSITS ARE RESULT OF EXCESSIVE RUNOFF FROM HEAVILY GRAZED AND FARMED UPLANDS. DRY STREAM BED TESTIFIES THAT WATER IS RUNNING OFF THE LAND INSTEAD OF INTO THE SOIL TO LATER APPEAR AS SEEPAGE AND SPRINGS.

IN THE FOREST AREAS ONLY A LIMITED AMOUNT OF FORAGE IS PRODUCED, NOT ENOUGH FOR ECONOMICAL USE BY DOMESTIC LIVESTOCK. ALSO THE AREA IS NEAR THE LARGER POPULATION CENTERS AND IS HEAVILY HUNTED. WILD LAND FORAGE IS MORE URGENTLY NEEDED FOR WILDLIFE THAN DOMESTIC STOCK.

WITHIN THE AREAS OF CLOSED RANGE, COMPLIANCE WITH THE LAW IS FAIRLY GOOD, EXCEPT IN LOCALIZED AREAS SUCH AS THE SOUTHERN PART OF WASHINGTON-CRAWFORD COUNTIES AND IN KOLIN AND DENT TOWNSHIP IN IRON COUNTY. HERE GREAT NUMBERS OF HOGS, HORSES AND CATTLE ARE STILL AT LARGE AND THE DAMAGE IS EXCESSIVE.

WATERSHED MANAGEMENT

PRESENTLY IT IS RECOGNIZED THAT THE STREAMS FLOWING OUT OF THE NATIONAL FOREST PRODUCE THE CLEAREST WATER IN THE BASIN. MAP - PAGE 56. IN SPITE OF THIS FACT, DURING HIGH WATER OR FLOOD STAGES, THESE STREAMS ARE STILL VERY TURBID. DAMAGING FLOODS SOMETIMES ORIGINATE ON WELL-MANAGED OR VIRGIN FORESTS. MORE OFTEN THEY RESULT FROM MISUSE OF THE LAND AND ITS PROTECTIVE VEGETATIVE COVER. THERE ARE A NUMBER OF TRACTS IN PRIVATE OWNERSHIP USED FOR CULTIVATION WHICH CONTRIBUTE HEAVILY TO THIS SEDIMENT AND TO THE ACCELERATED RUNOFF. THESE AREAS AND THE OTHER LANDS WHICH ARE USED EXCESSIVELY FOR GRAZING CONTRIBUTE THE MOST TO THE SEDIMENT IN THE STREAMS AND RETARD THE HEALING OF STREAM CHANNELS. PHOTO - PAGE 6.

LARGE GRAVEL BARS ARE CHOKING STREAMS AND ALTERING THEIR COURSES. THESE CHANGES USUALLY DESTROY VALUABLE BOTTOM LANDS. IT IS QUITE COMMON FOR THE LANDOWNERS TO ATTEMPT TO ALLEVIATE THEIR FLOOD DAMAGE BY DOZING THE DEPOSITS ASIDE TO REDUCE FLOODING AND RETAIN THE ORIGINAL COURSE. PHOTO - PAGE 7.

ACQUISITION

ACQUISITION OF LANDS FOR THE CLARK NATIONAL FOREST IN MISSOURI BEGAN IN 1934. AT THAT TIME THE LANDS WERE IN A VERY DEPLETED CONDITION, CUT-OVER, BURNED-OVER AND SEVERELY GRAZED. THE PRIMARY PURPOSES OF ESTABLISHING THE NATIONAL FOREST WERE TO PROTECT THE WATERSHEDS AND PROVIDE FOR FUTURE TIMBER PRODUCTION. IN THE MEREMAC BASIN SECTION OF THE CLARK NATIONAL FOREST, 93% OF THE LANDS WERE CONSIDERED SUITED FOR NATIONAL FORESTS AND ACQUIRABLE. PRESENTLY ONLY 48% HAS BEEN ACQUIRED IN THE BASIN.

THE ACQUISITION PROGRAM HAS BEEN VERY LIMITED SINCE THE EARLY 1940's. SINCE THEN, THIS PROGRAM HAS CONSISTED MAINLY OF LAND EXCHANGES MADE TO CONSOLIDATE NATIONAL FOREST LANDS FOR MORE ECONOMICAL AND EFFICIENT ADMINISTRATION. THERE ARE MANY FOREST LAND SALES EACH YEAR IN THE NATIONAL FOREST. MOST OF THE LANDS ARE BEST SUITED FOR NATIONAL FOREST PURPOSES AND CAN BE ACQUIRED, WITHOUT CONDEMNATION, AS RAPIDLY AS FUNDS ARE MADE AVAILABLE.



VIBURNUM, MISSOURI

A TOWN CARVED OUT OF THE WOODED LANDSCAPE AS THE RESULT OF
A NEW INDUSTRY. (ST. JOSEPH LEAD COMPANY'S BENEFICIATING
PLANT IN BACKGROUND.)



TIFF MINING OPERATION

TIFF MINING. NOTE SURFACE DISTURBANCE. REHABILITATION MUST
AWAIT EXPIRATION OF MINERAL RIGHTS.

STATUS OF ACQUISITION IN BASIN

	<u>ACRES</u>	<u>PERCENT OF AREA</u>
LANDS IN BASIN	396,360	100
LANDS PURCHASABLE IN BASIN	368,615	93
LANDS PURCHASED	191,174	48
BALANCE OF ACQUISITION PROGRAM	177,441	45

MINING

COMMERCIAL MINING IN THIS AREA HAS TAKEN PLACE FOR OVER 200 YEARS. WHEN THE NATIONAL FOREST PURCHASE PROGRAM BEGAN IN 1934, EXCEPT FOR TIFF, ALL ACTIVE DEEP MINING HAD BEEN TERMINATED. MANY LARGE ACRES WERE PURCHASED FROM LARGE MINING COMPANIES, BUT FULL FEE TITLE WAS SELDOM ACQUIRED FROM THEM. MINERALS RIGHTS WERE OUTSTANDING IN SOME CASES, AND IN OTHERS THE SURFACE WAS ACQUIRED WITH THE MINERALS RESERVED. THE NATURE OF THE RESERVATIONS WAS SUCH THAT THE FOREST SERVICE HAD VERY LITTLE CONTROL OVER EXTRACTION. THIS WAS TRUE IN THE EARLY PURCHASE CASES, BUT SUBSEQUENT ONES PROVIDED PROTECTION THROUGH THE DEEDS WHICH INCLUDED RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE.

MINING IN THE AREA IS IN TWO DIFFERENT CATEGORIES. ONE IS DEEP MINING FOR IRON AND LEAD WHICH DOES NOT DISTURB THE SURFACE EXCEPT IN A MINOR WAY. THE OTHER IS TIFF MINING WHICH DEFINITELY AFFECTS SURFACE MANAGEMENT. SEE PHOTO - TIFF OPERATION. PAGE 10.

MOST OF THE RESERVATIONS WERE FOR 25 YEARS AND HAVE EXPIRED. HOWEVER, ONE CASE INVOLVING 10,473 ACRES IS A 99-YEAR RESERVATION TO MINE ALL MINERALS, GAS AND OIL BY ANY KNOWN METHOD. THE RESERVATION HAS PROVISIONS FOR RENEWALS AT THE END OF SPECIFIED PERIODS. RIGHTS UNDER THIS RESERVATION ARE PRESENTLY EXERCISED FOR TIFF MINING. MAP - PAGE 41.

THE SURFACE RESOURCE IS DESTROYED BY THE TIFF OPERATION, BUT THE SUBSOILS ARE SUCH THAT THE MINED-OVER AREAS CAN, AT SOME FUTURE DATE, BE REHABILITATED.

THE MINING OF TIFF IS NOT CONFINED TO THE NATIONAL FOREST LANDS, BUT TWO OF THE WASHING PLANTS ARE ON THEM. IN 1961 THESE PLANTS BEGAN PROCESSING ORE FROM OTHER LANDS WHICH MADE THE MILL SUBJECT TO A SPECIAL USE PERMIT AND FOREST SERVICE CONTROL. RUNOFF AND SEDIMENTATION RESULTING FROM THIS OPERATION HAS BEEN OF MINOR NATURE.

THE SITUATION WITH MINERALS OTHER THAN TIFF HAS, SINCE THE MID 1950'S BEEN SUBJECTED TO INTENSIVE PROSPECTING. AS OF JUNE 30, 1962, THERE HAD BEEN 123 MINERAL PERMITS ON 131,744 ACRES, OF WHICH 6,198 ACRES HAD BEEN CONVERTED TO PREFERENCE RIGHT LEASES. THE ABOVE MINING ACTIVITY WAS NOT ENTIRELY WITHIN THE MEREMAC BASIN, BUT IN AND ADJACENT TO IT. PHOTO IS OF THE VIBURNUM PROCESSING MILL AND TOWN WHICH RECENTLY DEVELOPED FROM THIS MINERAL ACTIVITY. PAGE 9.

ESTIMATED FUTURE USE WITHOUT PROJECT DEVELOPMENTS

TIMBER

TIMBER HARVEST IS EXPECTED TO CONTINUE AT THE PRESENT ANNUAL ALLOWABLE CUT OF 7,580 MBM FOR THE REST OF THE PRESENT CUTTING CYCLE, 1962-1971. DURING THE NEXT CUTTING CYCLE, 1972-1981, IT IS EXPECTED THAT A MARKET FOR HARDWOOD PULPWOOD WILL BE AVAILABLE AND THE ANNUAL CUT WILL INCREASE TO 13,870 MBM AND 48,000 CORDS OF CORDWOOD.

FURTHER INCREASES IN TIMBER PRODUCTION ARE EXPECTED UNTIL THE YEAR 2040, AT WHICH TIME THE STANDS WILL BE IN FULL PRODUCTIVITY. SUSTAINED YIELD CAPACITY AT THAT TIME IS ESTIMATED AT 19,700 MBM AND 55,000 CORDS OF CORDWOOD ANNUALLY.

THE ABOVE ESTIMATE IS PREDICTED ON THE ASSUMPTION THAT ALL TIMBER STAND IMPROVEMENT, PLANTING AND CULL REMOVAL WILL BE COMPLETED BY 1980, AND THAT A MARKET WILL BE AVAILABLE FOR HARDWOOD PULPWOOD.

SILVICULTURAL PRACTICES NEEDED IN THE NEXT TWENTY YEARS ARE ESTIMATED TO USE 145,230 MAN DAYS. THIS IS IN ADDITION TO THE LABOR NEEDED FOR TIMBER HARVESTING.

RECREATION

RECREATIONAL USE IS INCREASING AND WILL CONTINUE TO INCREASE AS RAPIDLY AS ATTRACTIONS AND FACILITIES ARE PROVIDED. PROJECTIONS ON NFRS REPORT FOR THE BASIN PORTION OF THE NATIONAL FOREST SHOW THAT BY THE YEAR 2000, PICNICKING AND CAMPING WILL HAVE INCREASED OVER ELEVEN TIMES. OTHER FOREST RECREATION WILL INCREASE FIVE TIMES, AND ORGANIZATION CAMPING WILL BE IN SUBSTANTIAL AMOUNTS.

THE FOREST SERVICE PLANS ARE TO PROVIDE FOR THIS ANTICIPATED RECREATION USE INCREASE. MOST OF THE NATIONAL FOREST LANDS PURCHASED THUS FAR WERE CUT-OVER RIDGE LANDS WHICH PROVIDE FOR VERY LITTLE WATER ORIENTED RECREATION. AN IMPORTANT PART OF PROVIDING FOR THE ANTICIPATED RECREATION DEMANDS WILL REQUIRE ACQUISITION OF SITES WHERE WATER ORIENTED RECREATION CAN BE PROVIDED.

CONSIDERATION WILL BE GIVEN TO THE CONSTRUCTION OF RECREATION RESERVOIRS. ONE SUCH SITE IS NOW BEING CONSIDERED FOR CONSTRUCTION DURING THE ACCELERATED WORK PROGRAM. THIS SITE IS ON CLEAR CREEK, A TRIBUTARY OF BIG RIVER. THE PROPOSED DEVELOPMENT WILL PROVIDE A 90-ACRE RESERVOIR AND RECREATION FACILITIES. THIS RESERVOIR SHOULD HAVE LITTLE EFFECT ON LONG-TERM BASIN DEVELOPMENT. HOWEVER, DURING PREAUTHORIZATION STUDY AND CONSTRUCTION PHASES, IT WILL GIVE SOME RELIEF TO THE PRESENT RECREATION SHORTAGE. MAP - PAGE 41.

THE LARGEST DEVELOPED SITE IN PRESENT USE IS DAVISVILLE CAMP AND PICNIC AREA. THIS CAMP ON THE HUIZZAH CREEK IS A VERY ATTRACTIVE ONE, BUT ITS FUTURE IS THREATENED BECAUSE OF SERIOUS CREEK BANK WASHING. THIS WASHING, AND THE POSSIBLE CHANNEL CHANGE, REDUCE THE ATTRACTIVENESS OF THIS SITE. UPSTREAM FLOOD CONTROL IS A VERY ESSENTIAL PART OF PROTECTING THIS EXCELLENT SITE. SEE PHOTO - PAGE 4.



HUZZAH CREEK

SOURCE OF POLLUTION FROM A MARGINAL FARM OPERATION.

FISH AND GAME

FOLLOWING THE TREND OF INCREASING POPULATIONS WITH MORE TIME AVAILABLE FOR PLEASURE, IT IS ANTICIPATED THAT HUNTING AND FISHING PRESSURES WILL CONTINUE TO INCREASE AT AN EVEN GREATER PACE. PUBLIC HUNTING AREAS ARE DECREASING AS MANY PRIVATE OWNERS ARE POSTING THEIR LANDS TO PREVENT TRESPASS. THIS PLACES ADDED PRESSURE ON NATIONAL FOREST LANDS SINCE MANY OF THESE PRIVATE LANDS HERETOFORE HAVE BEEN USED BY THE PUBLIC.

GRAZING

GRAZING ON FOREST OR WOOD LANDS HAS BEEN DECLINING FOR SEVERAL DECADES. WITH NEARLY TWO-THIRDS OF THE AFFECTED AREA ALREADY HAVING VOTED FOR CLOSED RANGE, IT IS QUITE PROBABLE THAT THE REST OF THE AREA WILL BE CLOSED IN DUE TIME. MAP - PAGE 55.

CONSTANT PRESSURE WILL BE NEEDED TO UPHOLD THE LAW FOR A CONSIDERABLE TIME FOLLOWING CLOSURE.

WHERE THE STOCK LAWS ARE ENFORCED, IT DEVELOPS THAT A NUMBER OF FARMS HAVE TOO MANY LIVESTOCK FOR THEIR LAND BASE. SUCH FARMING PRACTICES SOON CAUSE A SERIOUS EROSION CONDITION. PROBLEM AREAS SUCH AS THESE WILL REQUIRE A SOLUTION, SINCE ONE SUCH FARM CAN NULLIFY MUCH OF THE EROSION CONTROL BENEFITS OF OTHER PROPERLY MANAGED LAND IN A WATERSHED. IN OTHER CASES, POLLUTION RESULTS FROM THESE MARGINAL OPERATIONS.

SEE PHOTO ON PAGE 7 OF EROSION AND PHOTO ON PAGE 13 OF A SOURCE OF POSSIBLE POLLUTION AS A RESULT OF THIS PRACTICE.

ACQUISITION

THE ACQUISITION PROGRAM IS LIMITED PRIMARILY BY THE AMOUNT OF FUNDS AVAILABLE FOR THIS ACTIVITY. IN ORDER TO FULFILL THE PUBLIC DEMAND FOR FOREST-TYPE RECREATION, SITES SUITED FOR THIS PURPOSE ARE HIGH PRIORITY ON THE FOREST'S PURCHASE AND EXCHANGE PLANS.

PROGRESS TOWARD THE ULTIMATE ACQUISITION GOALS IS DEPENDENT ON FUNDS BEING APPROPRIATED FOR THIS PURPOSE.

THE AVERAGE PRICE PAID FOR TIMBER LANDS IS ABOUT \$15.00 PER ACRE.

RECENT MINING INTERESTS HAVE CAUSED AN INFLATION OF THIS PRICE IN THE VICINITY OF PROSPECTING.

MINING

IT IS BELIEVED THE PEAK OF MINERAL PROSPECTING HAS BEEN REACHED AND THE BASIN AREA IS PRETTY WELL COVERED. THE CENTER OF THIS ACTIVITY HAS NOW MOVED SOUTH JUST OUT OF THE MEREMAC BASIN INTO THE BLACK AND CURRENT RIVER DRAINAGES.

IT IS EXPECTED THAT MINING (BARITE AND LEAD) WILL CONTINUE AT ABOUT THE PRESENT RATE.

WATERSHED MANAGEMENT

PAST LAND USE HAS PERMITTED EXCESSIVE RUNOFF. STREAM CHANNELS HAVE BEEN DAMAGED. PROTECTION AND MANAGEMENT HAS HALTED MUCH OF THIS DAMAGE ON WATERSHEDS OF NATIONAL FOREST OWNERSHIP. STREAM CHANNELS ON WATERSHEDS WHERE PRIVATE LANDS ARE NOT ADEQUATELY PROTECTED CONTINUE TO DETERIORATE. SEE PAGE 7.

A SAMPLE STUDY OF THE PRESENT AND POTENTIAL HYDROLOGIC CONDITIONS OF FORESTED LAND WAS MADE IN THE WATERSHED ABOVE RESERVOIR 1-26. THE SURVEY CONSIDERED THE COMPLEX RELATIONSHIP WHICH EXISTS BETWEEN WOODLAND COVER, AND THE USE AND TREATMENT OF THIS COVER WHICH REFLECTS ITS ABILITY TO INFLUENCE RUNOFF. FOLLOWING ARE THE SIX NUMERICAL AND QUALITATIVE HYDROLOGIC CONDITION CLASSES USED IN THIS SURVEY OF FORESTED LANDS:

CLASS 1 - VERY POOR; CLASS 2 - POOR; CLASS 3 - AVERAGE OR FAIR; CLASS 4 - GOOD; CLASS 5 - VERY GOOD; AND CLASS 6 - EXCELLENT;

THE CONDITIONS FOUND IN THE WATERSHED RANGED FROM VERY POOR TO GOOD, VARYING ACCORDING TO THE LAND USE. SOME PRIVATE LANDS ARE STILL SUBJECTED TO FIRE AND HEAVY GRAZING. ON THESE, THE HYDROLOGIC CONDITIONS ARE VERY POOR. OTHER PRIVATE LANDS, PROTECTED FROM FIRE AND LITTLE USED FOR GRAZING, ARE IN MUCH BETTER CONDITION. SOME NATIONAL FOREST LANDS WHICH ARE SUBJECTED TO OPEN RANGE GRAZING PRESSURE, ARE IN POOR HYDROLOGIC CONDITION. HOWEVER, GENERALLY CONDITIONS WERE FOUND TO BE MUCH BETTER. HYDROLOGIC CONDITIONS ON PRIVATE FOREST LANDS AVERAGED 2.4, OR A LOW-POOR HYDROLOGIC CONDITION CLASS. ON NATIONAL FOREST LANDS, THE HYDROLOGIC CONDITION WAS 3.8, OR A HIGH-AVERAGE HYDROLOGIC CONDITION CLASS.

THE RELATIVE CAPABILITY FOR IMPROVEMENT POTENTIAL OF HYDROLOGIC CONDITIONS FOR THE MOST OF THE AREA STUDIED WAS MEDIUM. UNDER PRESENT MANAGEMENT, NATIONAL FOREST LANDS WILL IMPROVE IN THE NEXT 25 YEARS TO A HYDROLOGIC CONDITION OF 4.6 WHICH IS TO BE CONSIDERED A HIGH-GOOD HYDROLOGIC CONDITION CLASS, WHILE AT THE SAME TIME, PRIVATE LANDS WILL IMPROVE TO A HYDROLOGIC CONDITION OF 3.6 OR A HIGH-FAIR HYDROLOGIC CONDITION CLASS.

THE SOIL CONSERVATION SERVICE LISTS THE PREDOMINATE SOIL IN THIS AREA AS HYDROLOGIC SOIL GROUP B. THIS GIVES THE FOLLOWING RUNOFF- PRECIPITATION CURVE VALUES FOR WOODED LAND: PRIVATE LAND - PRESENT R/P - 69; - FUTURE R/P IN 25 YEARS - 59. NATIONAL FOREST LAND PRESENT R/P - 57; FUTURE R/P IN 25 YEARS - 51.

THE SAMPLE STUDY INDICATES WHAT EFFECT NATIONAL FOREST RESOURCE MANAGEMENT HAS ON RUNOFF. ALTHOUGH THE STUDY WAS CONFINED TO THE WATERSHED OF 1-26, IT IS CONSIDERED TO BE REPRESENTATIVE OF WHAT IS PRESENT AND EXPECTED IN THE OTHER NATIONAL FOREST AREAS OF THE BASIN.

PROJECT IMPACTS ON CURRENT ACTIVITIES

THE CONSTRUCTION AND OPERATION OF THIS PROJECT WILL HAVE A SIGNIFICANT EFFECT ON THE PROTECTION, MANAGEMENT, DEVELOPMENT AND USE OF THE CLARK NATIONAL FOREST.

EFFECTS ON NATIONAL FOREST ACCESS AND TRANSPORTATION

APPROXIMATELY SEVEN MILES OF FOREST ROADS AND ONE LOW-WATER CROSSING WILL BE FLOODED AND REQUIRE RELOCATIONS WHICH WILL PARTLY BE ON NATIONAL FOREST LANDS. ANOTHER $1\frac{1}{2}$ MILES OF FOREST ROADS AND TWO LOW-WATER BRIDGES WILL BE SUBJECT TO FLOODING BY THE FLOOD CONTROL POOL. THE ABOVE ROADS, ALTHOUGH ON THE NATIONAL FOREST ROAD SYSTEM, ARE PRESENTLY BEING MAINTAINED BY LOCAL AUTHORITIES.

MERAMEC PARK RESERVOIR FLOOD CONTROL POOL WILL INUNDATE APPROXIMATELY ONE MILE OF F.S. ROAD #2265, INCLUDING A LOW-WATER BRIDGE. THIS ROAD IS MAINTAINED BY LOCAL AUTHORITIES, BUT IT SERVES NATIONAL FOREST AND PRIVATE LANDS.

RESERVOIR 1-14 WILL FLOOD APPROXIMATELY $\frac{1}{2}$ MILE OF F.S. ROAD #2411, INCLUDING A LOW-WATER CROSSING. THE FLOODING BY NORMAL POOL WILL RESULT IN TWO DEAD-END ROADS. ACCESS INTO THE AREA WILL NOT BE IMPAIRED EXCEPT FOR THROUGH TRAFFIC WHICH IS VERY LIGHT.

RESERVOIR 1-15A WILL FLOOD APPROXIMATELY $\frac{1}{2}$ MILES OF F.S. ROAD #2408 AND ONE LOW-WATER BRIDGE DURING FLOOD STAGES. ACCESS WILL BE IMPAIRED FOR THROUGH TRAFFIC.

RESERVOIR 1-26. F.S. ROAD #2382 WILL BE FLOODED OR MADE USELESS FOR APPROXIMATELY FOUR MILES BY THE NORMAL AND FLOOD POOL OF THIS PROJECT. THIS ROAD SERVES NATIONAL FOREST LANDS AS WELL AS PRIVATE LANDS.

RESERVOIR H-25 WILL FLOOD APPROXIMATELY $1\frac{3}{4}$ MILE OF F.S. ROAD #2394 AND $\frac{3}{4}$ MILE OF F.S. ROAD #2393. THESE ROADS ARE MAINTAINED BY LOCAL AUTHORITIES, AND SERVE NATIONAL FOREST LANDS AND PRIVATELY-OWNED LANDS IN THE IMPACT AREA.

ADDITIONAL MAINTENANCE OF EXISTING FOREST SERVICE ROADS TO THE DAMS AND AROUND THE RESERVOIRS WILL BE IMPOSED BY PROJECT CONSTRUCTION OF RESERVOIR AND APPURTENANT FACILITIES. DURING THE CONSTRUCTION PERIOD THE COST OF THIS PROJECT-IMPOSED MAINTENANCE SHOULD BE INCLUDED AS PART OF PROJECT COST TO BE FINANCED BY THE CONSTRUCTION AGENCY. RELOCATION ROAD STANDARDS SHOULD PROVIDE FOR THE SAME SERVICE PREVAILING BEFORE THE PROJECT AND FOR THE ADDITIONAL PROJECT-INDUCED USES.



FLOOD CONTROL POOL - BULL SHOALS RESERVOIR

AREAS OCCASIONALLY INUNDATED CAN BE MANAGED COOPERATIVELY
WITH THE MISSOURI CONSERVATION COMMISSION FOR WILDLIFE,
FOOD AND COVER.

EFFECTS ON TIMBER

THERE WILL BE NO MAJOR ADVERSE EFFECTS UPON FUTURE HARVEST OF NATIONAL FOREST TIMBER WITH THE RELOCATION AND REPLACEMENT OF ROADS NOW SERVING NATIONAL FOREST LANDS.

THE LARGE VOLUME OF HARDWOOD PULPWOOD AVAILABLE ON THE CLARK NATIONAL FOREST AND INTERVENING PRIVATE LANDS, TOGETHER WITH OTHER VOLUMES NEAR THE FOREST, IS MORE THAN AMPLE TO SUPPORT A PULP MILL. AN ADEQUATE SUPPLY OF CLEAN WATER IS ONE OF THE LIMITING FACTORS FOR DEVELOPING THIS INDUSTRY. OPPORTUNITY FOR DEVELOPING THIS INDUSTRY, WHICH WILL MATERIALLY ADD TO THE ECONOMY AND DEVELOPMENT OF THE REGION, WILL BE FULLY EXPLORED.

EFFECTS ON RANGE USE

THE LIMITED AMOUNT OF FORAGE WHICH IS PRODUCED IN THE NATIONAL FOREST LANDS IS PRIMARILY NEEDED FOR WILDLIFE RESOURCE. FIELD WORK ON THE NATIONAL FOREST RANGE RESOURCE POTENTIAL WAS COMPLETED RECENTLY. RESULTS FROM THIS SURVEY WILL SOON BE AVAILABLE TO GUIDE RANGE MANAGEMENT DECISIONS.

EFFECTS ON WILDLIFE USE

THE FLOOD PLAIN OF PROPOSED RESERVOIRS WILL BE MOSTLY ON LANDS IN PRIVATE AGRICULTURAL USE. REMOVING THESE AREAS FROM CROP PRODUCTION WILL REDUCE SOME FEEDING AREAS USED BY DEER AND SMALL UPLAND GAME. THE LOSS OF WILDLIFE HABITAT COULD BE MITIGATED BY THE ACQUISITION AND MANAGEMENT, FOR WILDLIFE, THOSE LANDS LYING BETWEEN THE RESERVOIR AND PRESENT NATIONAL FOREST LANDS.

THE FLOOD CONTROL POOL OF THE MERAMEC PARK RESERVOIR WILL COVER APPROXIMATELY 3,590 ACRES INSIDE THE NATIONAL FOREST. A GAME MANAGEMENT PROGRAM MADE IN COOPERATION WITH THE MISSOURI CONSERVATION COMMISSION SHOULD BE DIRECTED AT IMPROVING THIS AREA FOR WILDLIFE HABITAT WHEN THE PROJECT IS PUT INTO OPERATION. PHOTO - PAGE 17

EFFECTS ON RECREATION USE

THE LOWER REACHES OF HUIZZAH AND COURTOIS CREEKS ARE AMONG THE MOST HEAVILY FISHED STREAMS IN THE OZARKS. FLOODING OF THESE STREAMS BY THE MERAMEC PARK RESERVOIR WILL REDUCE THEIR QUALITY FOR FISHING ON APPROXIMATELY ELEVEN MILES OF THESE SCENIC CLEAR STREAMS. ALTHOUGH THE LANDS ALONG THESE STREAMS ARE PRIVATELY OWNED, THEIR POTENTIAL FOR FOREST-TYPE RECREATION WILL BE DESTROYED.

THE STREAMS ABOVE THIS RESERVOIR FLOOD POOL SHOULD BE IMPROVED FOR FISHING IF 1-15A, 1-14 AND 1-26 ARE CONSTRUCTED AND THE STREAM FLOW IMPROVED. THE INLETS OF THESE TWO CLEAR STREAMS INTO MERAMEC PARK RESERVOIR WILL MAKE EXCELLENT WHITE BASS SPAWNING AREAS.

DURING THE CONSTRUCTION PERIOD, THERE WILL BE AN INCREASE IN THE USE OF NATIONAL FOREST FACILITIES AND LANDS IN AND AROUND THE RESERVOIRS. IT IS EXPECTED THAT PART OF THIS USE WILL INCLUDE CAMPING AND PICNICKING ON SITES NOW UNDEVELOPED. THIS PROJECT-ATTRACTED USE BY WORKERS AND SIGHTSEERS WILL INCREASE THE NEEDS OF MANAGEMENT, PROTECTION, DEVELOPMENT AND MAINTENANCE OF NATIONAL FOREST LANDS.

THE FOREST SERVICE WILL NEED TO INSTALL RECREATIONAL FACILITIES, ADDITIONAL ACCESS ROADS, TRAILS, AND OTHER FACILITIES TO MEET INCREASED NEEDS FOR FIRE PROTECTION, TO INSURE PUBLIC SAFETY, TO SAFEGUARD PUBLIC HEALTH, AND FOR PUBLIC ENJOYMENT.

ADMINISTRATIVE AND RECREATION PATROL HEADQUARTERS WITH A PUBLIC INFORMATION CENTER WILL BE NEEDED FOR HANDLING THE INCREASED ADMINISTRATIVE LOAD IMPOSED BY THE INCREASED RECREATION USE INDUCED BY EACH PROJECT DEVELOPMENT.

EFFECTS ON PROTECTION

FOREST FIRES THAT MIGHT ORIGINATE IN CONNECTION WITH CONSTRUCTION WILL BE A THREAT TO NATIONAL FOREST-PROTECTED LANDS AND MAY REQUIRE SUPPRESSION ACTION. INTENSIFIED FIRE PROTECTION WILL BE NEEDED DURING PROJECT CONSTRUCTION. AFTER CONSTRUCTION, THE CHANCES OF FIRE WILL BE INCREASED BECAUSE OF ADDITIONAL RECREATION USE IN THE AREA. FIRE PREVENTION AND PROTECTION SERVICES WILL NEED TO BE INCREASED ABOVE PRESENT LEVELS TO MEET THIS RISK. WITH THE INCREASE IN VISITORS, AND FACILITIES TO HANDLE THEM, WE CAN EXPECT AN INCREASE IN PROPERTY DAMAGES. ADDITIONAL PROTECTION SERVICES WILL BE REQUIRED AND THE COST OF INCREASED FIRE PROTECTION SHOULD BE INCLUDED AS A PART OF PROJECT COST.

EFFECTS ON RESOURCE PLANS

THE CHANGES IN ACCESS AND LAND USE IMPOSED BY THIS PROJECT DEVELOPMENT WILL REQUIRE MAJOR REVISIONS TO THE NATIONAL FOREST FIRE CONTROL, TRANSPORTATION, RECREATION, TIMBER MANAGEMENT, WILDLIFE AND MULTIPLE USE MANAGEMENT RESOURCE PLANS.

EFFECTS ON PROPERTY LINES

THE CONSTRUCTION OF RESERVOIRS WILL INFLATE THE VALUE OF PROPERTY IN THE AREA AND, ESPECIALLY, ADJOINING RESERVOIRS. LAND VALUES IN THE PAST HAVE NOT WARRANTED THE COST OF LEGAL SURVEYS TO ESTABLISH PROPERTY LINES. WITH PROJECT INFLATION SUCH AS EXPERIENCED AT TABLE ROCK RESERVOIR, THESE PROPERTY LINES SHOULD BE RE-ESTABLISHED AND REFERENCE CORNERS PLACED ABOVE FLOOD PLAIN TO REDUCE FUTURE ADMINISTRATION COSTS AND TRESPASS. THERE ARE 101 FOREST SERVICE PROPERTY LINES INTERSECTING PROPOSED RESERVOIRS.

EFFECTS ON SANITATION

THE INCREASE IN POPULATION AND USERS IN THE AREA WILL HAVE A CORRES-

PONDING EFFECT ON SANITATION AND POLLUTION. BUSINESS, HOMES, RESORTS, ETC., WITHOUT ADEQUATE FACILITIES FOR DISPOSING OF REFUSE, RESORT TO UNAUTHORIZED DUMPING ON ISOLATED FOREST ROADS. IMPACT OF THIS UNAUTHORIZED PRACTICE IS DETRIMENTAL TO THE RECREATION AND SANITATION OF THE AREA AND POSES A FIRE PROBLEM.

EFFECTS ON ACQUISITION

AS PREVIOUSLY STATED, ONLY SMALL AREAS OF NATIONAL FOREST LANDS ARE INVOLVED IN THE RESERVOIR REQUIREMENTS. BETWEEN THE PROJECT LAND AND NATIONAL FOREST LANDS IS A ZONE OF PRIVATE LAND WHICH WILL OVERLOOK THE RESERVOIR AND BE ENHANCED TREMENDOUSLY BECAUSE OF ITS LOCATION.

PRIVATE DEVELOPMENTS IN THIS INTERVENING ZONE WILL OBLIGATE NATIONAL FOREST LANDS FOR ACCESS ROADS, POWER FACILITIES, COMMUNICATIONS, DUMP GROUNDS, ETC., AND YET PUBLIC MANAGEMENT WILL HAVE NO CONTROL OVER KIND OR NUMBER OF PRIVATE DEVELOPMENTS.

ALSO, MANY OF THE PUBLIC BENEFITS OF THE RESERVOIRS WILL BE AT STAKE. THE AESTHETIC FEATURES COULD BE ENDANGERED BY UNWISE DEVELOPMENT, POORLY ENGINEERED CONSTRUCTION OR OVER-USE COULD LEAD TO EROSION AND SANITATION PROBLEMS. THE POTENTIAL FOR WILDLIFE HABITAT AND PUBLIC RECREATION WOULD BE CONSIDERABLY REDUCED.

IN THE MERAMEC BASIN PROJECT, ONLY SIX PERCENT OF THE SHORELINE WILL BE WITHIN THE NATIONAL FOREST. THIS LIMITED PORTION SHOULD BE DEVELOPED WITH PUBLIC FACILITIES WHICH ARE APPROPRIATE TO THE FOREST ENVIRONMENT. IN ORDER TO ZONE OR CONTROL THE DEVELOPMENT, IT IS NECESSARY TO ACQUIRE CONTROL THROUGH PUBLIC OWNERSHIP. THE PATTERN OF NATIONAL FOREST LANDS SURROUNDING THE RESERVOIR IS SUCH THAT IT WILL BE IN THE PUBLIC INTEREST TO ACQUIRE THE LANDS BETWEEN THE RESERVOIR AND NATIONAL FOREST LAND IN ENTIRETY. SEE TABLE PAGE 40, MAP, PAGE 41.

PROJECT EFFECTS ON RESOURCE VOLUME AND VALUES

TIMBER

THERE WILL BE NO APPRECIABLE CHANGE ON TIMBER PRODUCTION OR VALUES ON NATIONAL FOREST LAND. WITHIN THE NATIONAL FOREST BOUNDARY, THE PRIVATE LANDS FLOODED GENERALLY ARE IN AGRICULTURAL USE. TIMBER PRODUCTION LOST FROM THESE LANDS IS OF LITTLE CONSEQUENCE.

GRAZING

THE GRAZING RESOURCE IS VERY LIMITED AND NOT MANAGED FOR DOMESTIC STOCK USE. CONSEQUENTLY, THE CONSTRUCTION OF THE RESERVOIRS WILL NOT AFFECT THIS RESOURCE. THE DEVELOPMENT OF THE RECREATION FACILITIES IN OPEN RANGE AREAS WILL REQUIRE AN ADDITIONAL EDUCATION AND LAW ENFORCEMENT PROGRAM TO CONTROL TRESPASS IN PREFERENCE TO PROTECTION OF THE IMPROVEMENTS BY FENCING.

MINING

CERTAIN LANDS OF NATIONAL FOREST HAVE BEEN ACQUIRED WITH MINERAL RESERVATIONS WITHOUT RESTRICTIONS AGAINST SURFACE DESTRUCTION. THE RESERVATIONS ARE RENEWABLE AND WILL BE A THREAT TO ANY DEVELOPMENTS WHICH MAY BE PROPOSED ON OR NEAR THESE LANDS. THERE ARE 400 ACRES OF NATIONAL FOREST LAND NEAR PROJECT 1-15A WHERE THE MINERAL RESERVATIONS WILL SERIOUSLY AFFECT THE PROJECT PURPOSE. ACQUISITION OF THESE OUTSTANDING RIGHTS IS RECOMMENDED.

FISHING

ELEVEN MILES OF CLEAR-FLOWING STREAM FISHERY WILL BE REPLACED BY A FLUCTUATING RESERVOIR FISHERY OF THE MERAMEC PARK RESERVOIR. ALTHOUGH THE INCIDENTAL FISHING BENEFITS FROM THE PROJECTS 1-14, 1-15A AND 1-26 WILL EXCEED EXISTING USER-DAYS VALUES ON THESE STREAMS, MITIGATION MEASURES FOR THE LOSS IN QUALITY OF FISHING ARE NECESSARY. PROVISION FOR MULTIPLE-LEVEL OUTLETS ON THE INTERMEDIATE RESERVOIRS ON THESE STREAMS ARE NEEDED FOR CONTROL OF TEMPERATURE AND COMPOSITION OF DOWN STREAM RELEASES AS WELL AS FLUCTUATION OF FLOW TO ASSURE A SUITABLE ENVIRONMENT FOR WARM WATER FISHING.

ACQUISITION

DEVELOPMENT OF THE RESERVOIRS AND THE RECREATION FACILITIES WILL INFLATE THE PRICE OF ALL LANDS IN THE FOREST.

NATIONAL FOREST ACQUISITION PROGRAMS WILL BE IN COMPETITION WITH RECREATION BASED BUSINESSES, PRIVATE HUNTING AND FISHING CABINS, SUMMER HOMES, PRIVATE CLUBS, RESORTS, SPECULATORS AND DEVELOPMENT COMPANIES. PRICE INCREASES COULD BE IN SUCH PROPORTION AS TO PRECLUDE NATIONAL FOREST ACQUISITION.

APPRAISAL OF PROJECT IMPACTS

THIS APPRAISAL IS BASED UPON LIMITED FACTUAL INFORMATION. ESTIMATES ARE BASED UPON 1962 DATA AND PRELIMINARY RESERVOIR INFORMATION OF WHICH THE DETAILS ARE TENTATIVE. IMPACTS AND ESTIMATES MAY REQUIRE CHANGING AS DETAILED INFORMATION BECOMES AVAILABLE FROM PROJECT PLANNING NOW IN PROCESS.

RELOCATION AND RESTORATION

WE RECOMMEND THAT FACILITIES AND SERVICES INUNDATED OR IMPAIRED AS A RESULT OF PROJECT CONSTRUCTION SHOULD BE RELOCATED AND RESTORED TO PROVIDE THE SAME LEVEL OF SERVICE PREVAILING BEFORE PROJECT AND FOR THE ADDITIONAL PROJECT-INDUCED USE. THIS PHASE OF THE PROGRAM SHOULD BE DONE IN ADVANCE OF OR CONCURRENTLY WITH PROJECT CONSTRUCTION SO THAT THERE WILL BE LITTLE OR NO INTERRUPTION IN FOREST SERVICE ADMINISTRATION AND PUBLIC USE. FOR THOSE IMPROVEMENTS WHICH WILL BE ON NATIONAL FOREST LANDS, THE FOREST SERVICE SHOULD APPROVE LOCATIONS, DESIGNS, AND STANDARDS.

TRANSPORTATION SYSTEMS

PORTIONS OF SIX FOREST SERVICE ROADS WILL BE INUNDATED BY THE PROPOSED RESERVOIRS. THESE ROADS ARE A PART OF THE FOREST SERVICE ROAD SYSTEM. (SEE COMPOSITE MAP.) THEY PROVIDE ACCESS FOR USE AND PROTECTION TO NATIONAL FOREST LANDS AS WELL AS TO PRIVATELY-OWNED LANDS IN THE IMPACT AREA. RELOCATION AND RESTORATION OF THESE ROADS TO PROVIDE THE SAME LEVEL OF SERVICE THEY NOW FURNISH SHOULD BE INCLUDED IN PROJECT PLANNING AND CONSTRUCTION BY THE CONSTRUCTION AGENCY.

PORTIONS OF THE ROADS THAT WILL BE FLOODED AND THE PROPOSED RELOCATIONS ARE ALSO ON THE COMPOSITE MAP. PAGE 41.

I. ROADS FLOODED

- A. ROCKY FORD ROAD FDR #2382. FOUR MILES OF THIS ROAD ALONG WEST FORK OF HUZDAH CREEK WILL BE FLOODED BY RESERVOIR I-26.
- B. COUNCIL BLUFF ROAD FDR #2394. 1-3/4 MILES OF THIS ROAD ALONG BIG PINEY RIVER WILL BE FLOODED BY RESERVOIR H-25.
- C. TELLECK ROAD FDR #2393. 3/4 MILE OF THIS ROAD FROM FDR #2394 TO HIGH WATER LINE WILL BE FLOODED BY RESERVOIR H-25.
- D. BALD KNOB ROAD FDR #2411. 1/2 MILE OF THIS ROAD AND A LOW-WATER BRIDGE ACROSS HUZDAH CREEK WILL BE FLOODED BY RESERVOIR I-14.

- E. BRAZIL PALMER ROAD FDR #2408. $\frac{1}{2}$ MILE OF THIS ROAD AND LOW-WATER BRIDGE ACROSS COURTOIS CREEK WILL BE FLOODED BY RESERVOIR 1-15A.
- F. FLOYD BUTTS ROAD FDR #2265. ONE MILE OF THIS ROAD AND LOW-WATER BRIDGE ACROSS COURTOIS CREEK WILL BE FLOODED.

2. PROPOSED ROAD RELOCATIONS - TABLE 1, PAGE 31.

- A. FLOYD BUTTS ROAD FDR #2265. THE PROPOSED RELOCATION IS APPROXIMATELY FOUR MILES IN LENGTH AND CROSSES COURTOIS CREEK ABOVE FLOOD POOL OF MERAMEC PARK RESERVOIR. THE SOUTHERLY TERMINUS WILL BE ON STATE HIGHWAY #8 AT A POINT 13 MILES EAST OF STEELVILLE. IT WILL EXTEND NORTHEASTERLY OVER EXISTING ROAD FDR #2433 APPROXIMATELY $1\frac{1}{2}$ MILES TO A POINT WHERE THE ROAD TURNS SOUTHEAST. FROM THIS POINT, THE PROPOSED ROAD CONTINUES NORTHEASTERLY $2\frac{1}{2}$ MILES TO JUNCTION WITH EXISTING FLOYD BUTTS ROAD FDR #2265. WHEN CONSTRUCTED, THIS ROAD WILL REPLACE THE PORTION OF FDR #2265 WHICH WILL BE MADE UNUSABLE BY THE FLOODING.
- B. WALNUT HOLLOW ROAD FDR #2388. THE PROPOSED RELOCATION IS APPROXIMATELY FOUR MILES IN LENGTH. THE NORTHERN TERMINUS IS AT 1-26 DAM. IT WILL EXTEND IN A SOUTHERLY DIRECTION TO JUNCTION WITH STATE HIGHWAY #32 ONE MILE WEST OF BOSS, MISSOURI. WHEN CONSTRUCTED, THIS ROAD WILL REPLACE THE PORTION TO BE FLOODED.
- C. COUNCIL BLUFF ROAD FDR #2394. THE PROPOSED RELOCATION IS APPROXIMATELY $1\frac{1}{2}$ MILES IN LENGTH. THE EASTERN TERMINUS IS NEAR THE COUNCIL BLUFF CHURCH, AND IT WILL EXTEND IN A NORTHWESTERLY DIRECTION TO JUNCTION WITH STATE HIGHWAY DD.

3. BRIDGES

THE THREE BRIDGES WHICH WILL BE FLOODED ARE NOT SALVABLE.

A CONCRETE LOW-WATER CROSSING WILL NOT BE REQUIRED ON RELOCATED FLOYD BUTTS ROAD FDR #2265 DISCUSSED ABOVE.

THE BRIDGE ACROSS HUZDAH CREEK ON BRAZIL PALMER ROAD FDR #2408, WHICH WILL BE FLOODED BY RESERVOIR 1-15A, NEED NOT BE REPLACED SINCE PRELIMINARY PLANS FOR 1-15A DAM INCLUDE A ROADWAY ACROSS THE DAM. THIS WILL PROVIDE FOR THROUGH TRAFFIC ON FDR #2405 AND #2395.

PUBLIC LAND SURVEY CORNERS

A NUMBER OF PUBLIC LAND SURVEY CORNERS WILL BE INUNDATED. REFERENCE CORNERS AND PROPERTY LINES WILL NEED TO BE ESTABLISHED ON THE BASIS OF THE NEED TO SEPARATE LAND RESERVATIONS PECULIAR TO INDIVIDUAL TRACTS. ESTIMATED COST OF SURVEY IS SHOWN IN TABLE 1 FOR INFORMATION. PAGE 31.



PRIVATE RECREATION DEVELOPMENT

PRIVATE CAMP AND PICNIC SITE ON HUZZAH CREEK BELOW I-14.
OPERATED ON A DAILY FEE BASIS.



KNOBLETT RECREATION AREA - MARK TWAIN N. F.

CAMPING SITE - SIMILAR RECREATION AREAS ARE PLANNED FOR
MERAMEC BASIN RESERVOIRS.

ADMINISTRATIVE AND PROTECTIVE COSTS

ADDITIONAL MAINTENANCE OF EXISTING ROADS IN THE VICINITY OF EACH RESERVOIR WILL BE NEEDED DURING PROJECT CONSTRUCTION. THE COST OF THIS INCREASED MAINTENANCE AND OF INTENSIFIED FIRE PROTECTION DURING THE CONSTRUCTION PERIOD SHOULD BE INCLUDED AS A PART OF PROJECT COSTS TO BE FINANCED BY THE CONSTRUCTION AGENCY. ESTIMATES OF THESE COSTS ARE SHOWN IN TABLE I. PAGE 31.

PROJECT CONSTRUCTION CONTRACTS SHOULD CONTAIN APPROPRIATE ROAD MAINTENANCE AND FIRE LIABILITY CLAUSES, AND CONTRACTORS SHOULD BE REQUIRED TO FURNISH BONDS COVERING LOSSES AND SUPPRESSION COSTS OF FOREST FIRES ORIGINATING IN CONNECTION WITH PROJECT CONSTRUCTION.

NEW FACILITIES NEEDED TO HANDLE PROJECT-IMPOSED PUBLIC USE, TO PROTECT PUBLIC PROPERTY, TO SAFEGUARD PUBLIC HEALTH, AND TO INSURE PUBLIC SAFETY

PAST EXPERIENCE WITH A SIMILAR PROJECT, THE TABLE ROCK RESERVOIR ON WHITE RIVER, MARK TWAIN NATIONAL FOREST, CONSTRUCTED BY THE CORPS OF ENGINEERS, U. S. ARMY, INDICATES THERE WILL BE A LARGE INCREASE IN RECREATION USE DURING AND AFTER PROJECT CONSTRUCTION. THE FOREST SERVICE WILL PLAN, DEVELOP, MAINTAIN AND ADMINISTER RECREATION AND OTHER PUBLIC USES AND FACILITIES ON NATIONAL FOREST LANDS SUBJECT TO THE CONTINUED AVAILABILITY FOR FLOOD CONTROL WORK. CONSIDERATION WILL BE GIVEN, WITHIN THE LIMITED OPPORTUNITIES AVAILABLE, TO PRIVATE DEVELOPMENT OF RESORTS, MARINAS AND SERVICES UNDER SPECIAL USE PERMIT. THE FOREST SERVICE WILL ALSO WORK WITH THE CORPS OF ENGINEERS IN MAKING OVERALL PLANS FOR FUTURE RECREATION USE OF THE RESERVOIR AREAS IN AND NEAR THE CLARK NATIONAL FOREST. THIS WILL BE DONE IN ACCORDANCE WITH THE MEMORANDUM OF AGREEMENT BETWEEN THE SECRETARY OF WAR AND SECRETARY OF AGRICULTURE DATED DECEMBER 16, 1946.

THE INCREASED RECREATIONAL USE WILL EXTEND ONTO ADJOINING AND NEARBY NATIONAL FOREST LANDS. ADDITIONAL FACILITIES WILL BE NEEDED ON (PHOTO - PAGE 25) THESE LANDS TO SAFEGUARD PUBLIC HEALTH AND SAFETY, PREVENT THE POLLUTION OF WATER SUPPLY, PROTECT PUBLIC PROPERTY, AND PROVIDE FOR PUBLIC ENJOYMENT. THIS WILL REQUIRE DEVELOPMENT OF RECREATION SITES, WATER AND SANITARY FACILITIES, ROADS AND OTHER FACILITIES OF NATIONAL FOREST LANDS. ESTIMATES ARE SHOWN IN TABLE II. THE COSTS ARE TO BE FINANCED BY THE FOREST SERVICE. PAGE 33.

SWIMMING AREAS

RESERVOIR SWIMMING AREAS HAVE MANY UNDESIRABLE FEATURES WHICH REDUCE THEIR POPULARITY. IN ADDITION, IT IS IMPRACTICAL AND DIFFICULT TO PROVIDE FOR SAFE WATER AND SWIMMING CONDITIONS.

WATER LEVELS NATURALLY FLUCTUATE WITH RAINFALL, WHICH ALSO AFFECTS TURBIDITY AND SEDIMENT AND DEBRIS IN THE BEACH AREAS, MAKING THEM



PROPOSED SWIMMING AREA

AREA BELOW PROPOSED DAM 1-14. SUITED FOR DEVELOPMENT
OF SWIMMING AREAS FREE FROM OBJECTIONABLE FEATURES OF
RESERVOIR SWIMMING.

UNDESIRABLE. DEPTH MARKERS AND OTHER SAFETY FEATURES ARE DIFFICULT TO MAINTAIN. WATER MAY BE TURBID, OR EVEN IF IT IS CLEAR, THE SEDIMENT ON BOTTOMS IS SOON STIRRED UP THROUGH USE. SANITATION THROUGH CHLORINATION IS NOT PRACTICAL. AQUATIC VEGETATION IS ALSO A PROBLEM. CONFLICTS BETWEEN BOATING AND SWIMMING AREAS ARE ALWAYS PRESENT.

TO REDUCE THE OBJECTIONABLE FEATURES OF RESERVOIR SWIMMING AND YET PROVIDE FOR THIS WATER-ORIENTED RECREATION, A POOL IS PROPOSED BELOW EACH OF THE DAMS HAVING SUFFICIENT OUTFLOW FOR SUCH A FACILITY. THE POOLS WILL RETAIN SUCH NATURAL FEATURES AS SAND BEACHES AND BOTTOMS, TOGETHER WITH NATURAL SURROUNDINGS OF SCENIC BLUFFS AND FORESTED HILLS. WATER LEVELS WILL BE REGULATED BY INTAKE CONTROLS FROM THE DAMS. SANITATION EQUIPMENT FOR CHLORINATION, IF NEEDED, CAN BE INSTALLED. WATER WILL BE CONTINUOUSLY CHANGING AND SEDIMENT WILL BE REDUCED TO NIL. VEGETATION PROBLEMS ARE ALSO ELIMINATED. DURING THE OFF SEASON THE POOL CAN BE DRAINED AND THE FLOOR OF POOL AND BEACHES REPAIRED AND EXPOSED TO THE SUN FOR PURIFICATION UNTIL THE NEXT SEASON. FOR PHOTO OF A PROPOSED SITE SEE PHOTO - PAGE 27.

ADJUSTMENT OF LANDOWNERSHIP AND MANAGEMENT RESPONSIBILITIES

NATIONAL FOREST LANDS IN AND ADJACENT TO EACH RESERVOIR SITE SHOULD BE MANAGED TO ENHANCE FUTURE RECREATION OR OTHER PUBLIC PURPOSES THAT CAN BE DETERMINED IN LINE WITH PROJECTED NEEDS. THE ADJACENT NON-FEDERAL LANDS WHICH WILL BE SUITABLE FOR PUBLIC RECREATION OR OTHER PUBLIC USE OR WHICH WILL CONTROL ACCESS TO THE RESERVOIR SHOULD BE ACQUIRED IN ADVANCE OF PROJECT AUTHORIZATION.

THE WILD TIMBER LANDS NORTH OF THE NATIONAL FOREST AND EAST OF THE MERAMEC PARK RESERVOIR ARE WELL SUITED TO FACILITATE MANY OF THE DESIRABLE FEATURES OF THE BASIN PROGRAM SUCH AS TO PROVIDE FOR INCREASED PUBLIC HUNTING, RECREATION, TIMBER PRODUCTION AND ACCESS TO THIS MAJOR RESERVOIR. AN EXTENSION OF THE NATIONAL FOREST TO INCLUDE THESE LANDS FOR MULTIPLE USE MANAGEMENT AND PROTECTION WOULD INCREASE THE PUBLIC BENEFITS OF THE PROJECT. THE PROPOSED NATIONAL FOREST EXTENSION IS SHOWN ON MAP ON PAGE 60.

WITHDRAWN AND ACQUIRED LANDS NEEDED FOR RECREATION OR OTHER PUBLIC PURPOSES SHOULD BE RETAINED IN PUBLIC OWNERSHIP AND ADMINISTERED AND DEVELOPED BY A PUBLIC AGENCY OR AGENCIES TO SERVE AND PROTECT THE PUBLIC INTERESTS AND VALUES, AND TO PROVIDE FOR PUBLIC ACCESS TO THE RESERVOIR AREAS SUBJECT TO THEIR CONTINUED AVAILABILITY FOR FLOOD CONTROL WORK.

PUBLIC INTERESTS AND VALUES REPRESENTED BY RECREATION AND OTHER USES WHICH WILL BE CREATED OR AFFECTED BY THIS PROJECT WOULD APPEAR TO BE MOST EFFECTIVELY AND ECONOMICALLY SERVED BY HAVING A SINGLE PUBLIC AGENCY RESPONSIBLE FOR THE ADMINISTRATION AND MANAGEMENT OF ALL LANDS AND FACILITIES SURROUNDING THE RESERVOIR WHICH ARE NOT NEEDED FOR FLOOD CONTROL WORKS. THIS COULD BE FACILITATED BY GIVING NATIONAL FOREST STATUS TO ALL LANDS ACQUIRED BY THE UNITED STATES FOR, AND IN CONNECTION WITH, THE MERAMEC BASIN PROJECT WITHIN

THE EXTERIOR BOUNDARIES OF THE CLARK NATIONAL FOREST. IT WOULD ALSO BE CONSISTENT WITH NATIONAL FOREST AUTHORITY AND PROGRAMS IN THE AREA. SUCH ACTION WOULD PERMIT THE UTILIZATION OF THE FRAMEWORK OF THE SUPERVISORY PERSONNEL AND MANAGEMENT FACILITIES NOW AVAILABLE ON THE CLARK NATIONAL FOREST FOR ALL WITHDRAWN AND ACQUIRED LANDS.

THE FOREST SERVICE IS RESPONSIBLE FOR THE MANAGEMENT, DEVELOPMENT AND PROTECTION OF NATIONAL FOREST LAND IN ACCORDANCE WITH PUBLIC LAW #86-517, MULTIPLE USE - SUSTAINED YIELD ACT. WITHIN THE NATIONAL FOREST BOUNDARY, RECREATIONAL AND OTHER PUBLIC USE OF THE RESERVOIRS AND THE PERIMETER WILL HAVE SIGNIFICANT EFFECTS UPON THESE SERVICES. IT IS, THEREFORE, DESIRABLE THAT THE FOREST SERVICE DEVELOP, ADMINISTER AND MANAGE THE RECREATIONAL AND OTHER FACILITIES AND USES ON ALL WITHDRAWN AND ACQUIRED LANDS WITHIN THE NATIONAL FOREST SUBJECT TO THEIR CONTINUED AVAILABILITY FOR FLOOD CONTROL WORK.

ADVANCE PLANNING AND OTHER SERVICES

CLOSE LIAISON BETWEEN AGENCIES IS ESSENTIAL IF INTERFERENCE WITH CURRENT FOREST ADMINISTRATION AND SERVICES IS KEPT TO A MINIMUM DURING THE CONSTRUCTION PERIOD. MEMORANDUMS OF AGREEMENT BETWEEN THE AGENCIES CONCERNED ARE NECESSARY TO PROVIDE FOR DETAILED PLANNING, FOR RECONSTRUCTION AND REPLACEMENT OF FACILITIES AND SERVICES, AND FOR INCREASED MANAGEMENT NEEDS DURING THE CONSTRUCTION PERIOD. COSTS TO FINANCE A LIAISON AND ADMINISTRATIVE WORK ARE INCLUDED IN TABLE II. PAGE 33.

INCREASED PROTECTION AND MANAGEMENT COSTS AFTER CONSTRUCTION

TO ADEQUATELY REDEEM ITS PUBLIC RESPONSIBILITY, IT IS ESSENTIAL THAT THE FOREST SERVICE PROTECT THE NATURAL RESOURCES AND MAINTAIN THE RECREATIONAL IMPROVEMENTS CONSTRUCTED ON NATIONAL FOREST LANDS TO MEET PROJECT-IMPOSED NEEDS AND PROVIDE ADMINISTRATIVE SERVICES TO MANAGE THESE DEVELOPMENTS. ESTIMATES FOR THESE SERVICES ARE SHOWN IN TABLE III. PAGE 34. FUNDS TO COVER SUCH COSTS WILL BE REQUESTED BY THE FOREST SERVICE IN ITS REGULAR BUDGET PROCEDURE.

CHANGES IN RESOURCE VALUES

THERE WILL BE NO APPRECIABLE CHANGE IN TIMBER PRODUCTION OR HARVESTING COSTS ON EITHER NATIONAL FOREST OR OTHER PRIVATELY-OWNED LANDS. APPROXIMATELY 287 ACRES WILL BE INUNDATED, BUT THIS WILL ONLY BE A MINOR LOSS IN FUTURE PRODUCTION.

DEVELOPMENT OF THE RESERVOIRS WILL ATTRACT INCREASED NUMBERS OF RECREATION VISITORS FOR PICNICKING, SWIMMING, FISHING, BOATING, CAMPING, HIKING AND RELAXATION. BY 1970 THIS PROJECT-CREATED INCREASE IS ESTIMATED AT 222,500 VISITS ANNUALLY IN PUBLIC USE CAMPING

AND PICNICKING. A MONETARY VALUE OF \$1.60 PER DAY, AMOUNTING TO \$356,000, FOR THESE RECREATIONAL BENEFITS IS INCLUDED IN TABLE III. PAGE 34. THE ESTIMATE IS CONSIDERED A CONSERVATIVE INDICATION OF THE RECREATION VISITS WHICH WILL BE CONSISTENT WITH DISPERSED FOREST-TYPE DEVELOPMENTS AND WHICH CAN BE EVALUATED MONETARILY. THIS EVALUATION DOES NOT INCLUDE ADDITIONAL AESTHETIC AND INDIRECT BENEFITS WHICH ARE NOT SUBJECT TO EVALUATION IN MONETARY TERMS.

REPRESENTATIVES OF THE NATIONAL PARK SERVICE, BUREAU OF OUTDOOR RECREATION AND THE FOREST SERVICE HAVE CONFERRED ON THE RECREATIONAL ASPECTS OF THE RESERVOIRS INSIDE THE NATIONAL FOREST. THE THREE AGENCIES ARE IN GENERAL AGREEMENT AS TO THE TYPE OF RECREATION TO BE PROVIDED BY THE RESERVOIRS AND THE FACILITIES FOR THIS USE. THE FOREST SERVICE ESTIMATES INCLUDE THE BENEFITS OF AND PROVISIONS FOR THE ANTICIPATED INCREASED RECREATION USE INDUCED BY THE PROJECT ON NATIONAL FOREST AND ACQUIRED LANDS NEARBY AND ADJACENT TO THE RESERVOIR AREA.

TABLE 1. -- ESTIMATED COSTS OF REPLACING EXISTING FACILITIES AND SERVICES, AND ADMINISTRATIVE AND PROTECTIVE SERVICES. 1/

	UNITS	COST
I. FACILITIES REQUIRED TO MAINTAIN PRESENT LEVEL OF MANAGEMENT AND SERVICES.		
A. ROADS		
(1) ROAD FROM HIGHWAY No. 8 TO FOREST SERVICE ROAD F.D.R. #2265 TO REPLACE FLOODED SECTION ON ROAD F.D.R. #2265 F.D.R. #2268 (NEW CONSTRUCTION) F.D.R. #2433 (RECONSTRUCTION)	2.5 MILES 1.5 MILES	\$ 25,000 7,500
(2) ROAD FROM HIGHWAY 32 TO DAM 1-26 TO REPLACE FLOODED ROAD F.D.R. #2382 BY RESERVOIR 1-26 F.D.R. #2383	4.0 MILES	\$ 40,000
(3) ROAD FROM HIGHWAY DD TO ROAD F.D.R. #2394 TO REPLACE FLOODED F.D.R. #2394 BY RESERVOIR H-25	1.5 MILES	\$ 15,000
(4) ROAD FROM FOREST SERVICE ROAD F.D.R. #2247 TO HIGHWAY Y VIA 1-15 DAM TO REPLACE FLOODED ROAD F.D.R. #2408	5.0 MILES	\$ 50,000
CONTINGENCY ALLOWANCE (25% OF PRECEEDING ITEMS)		34,375
SUBTOTAL.....		\$171,875
B. ESTABLISH REFERENCE CORNERS		\$101,500
CONTINGENCY ALLOWANCE 25%		25,375
SUBTOTAL.....		\$126,875

1/ THESE COSTS SHOULD BE CONSIDERED A PART OF CONSTRUCTION AND BE PAID OUT OF PROJECT FUNDS.

(CONTINUED ON PAGE 32)

TABLE 1. -- CONTINUED

2. ADMINISTRATIVE AND PROTECTIVE SERVICES

A. EXTRA FIRE PROTECTION MADE NECESSARY
BY CONSTRUCTION ACTIVITY \$ 3,800

B. INCREASED MAINTENANCE MADE NECESSARY
BY CONSTRUCTION ACTIVITY

(A.)	ROADS	\$ 5,200
------	-------	----------

CONTINGENCY 25% \$ 2,250

SUBTOTAL.....\$ 11,250

GRAND TOTAL	\$ 310,000
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(CONTINGENCY ALLOWANCE OF 25% IS USED BY CORPS OF ENGINEERS)

TABLE 11. -- ESTIMATED COSTS OF PROVIDING FACILITIES AND SERVICES
TO MEET ADDITIONAL USE ATTRACTED BY THE PROJECT 1/

	UNITS	COST
1. NEW FACILITIES TO PROVIDE BASIC PROTECTION FOR PUBLIC HEALTH, SAFETY AND PROPERTY.		
A. ROADS: RAISE SERVICE STANDARDS OF FOREST SERVICE ROADS FDR #2411, #2408 #2247 AND #2265, AND CONSTRUCT ACCESS ROADS TO AND WITHIN RECREATION SITES, AND SIGNING <u>2/</u>	37.0 MILES	\$544,500
B. CAMPGROUNDS, PICNIC SITES AND ASSO- CIATED FACILITIES <u>3/</u>	20 SITES	575,740
C. DOCKS, BOAT LANDINGS, PARKING AREAS AND SIGNS	6 SITES	89,925
D. SWIMMING BEACHES AND POOLS	4	88,000
E. RECREATION ADMINISTRATION HEADQUARTERS	2	55,000
F. TRAILS, INTERPRETIVE SERVICE	15 MILES	16,500
G. LANDSCAPING, SEEDING	90 ACRES	19,800
2. ADMINISTRATIVE SERVICES		
A. ADVANCE PLANNING, LIAISON AND ADMINISTRATIVE SERVICES DURING CONSTRUCTION	9 MAN- MONTHS	11,880
TOTAL		\$1,401,345
CONTINGENCY ALLOWANCE OF 10% IS INCLUDED IN PRECEDING ITEMS		
<u>1/</u> THE FACILITIES ARE TO BE LOCATED ON LANDS HAVING NATIONAL FOREST STATUS. FUNDS FOR THE INSTALLATION OF THE FACILITIES, ADVANCE PLANNING AND ADDITIONAL ADMINISTRATIVE SERVICES WILL BE REQUESTED UNDER FOREST SERVICE AUTHORITY AND FOREST SERVICE APPROPRIATIONS.		
<u>2/</u> ULTIMATE DEVELOPMENT OF ALL AREAS WILL REQUIRE THE CONSTRUCTION OF 13.8 ADDITIONAL MILES OF NEW SITE ACCESS AND APPROACH ROADS.		
<u>3/</u> ULTIMATE DEVELOPMENT OF RECREATION WILL REQUIRE THE CONSTRUCTION OF 8 ADDITIONAL CAMP AND PICNIC SITES.		

TABLE III -- ECONOMIC EFFECTS OF PROJECT ON NATIONAL FOREST
RESOURCES AND SERVICES ^{1/}

	ANNUAL LOSS OR ADDITIONAL COSTS	ANNUAL GAIN
1. INCREASED MANAGEMENT COST FOLLOWING INSTALLATION		
A. PERSONNEL SERVICES FOR INCREASED FIRE PROTECTION AND GENERAL ADMINISTRATION	\$ 2,450	-
B. MAINTENANCE AND MANAGEMENT OF RECREATION FACILITIES	44,500	-
C. INCREASED ROAD MAINTENANCE	10,300	^{2/}
SUBTOTAL	\$57,250	
2. CHANGES IN RESOURCE VALUES		
A. FORAGE PRODUCTION CAPACITY	0	0
B. TIMBER PRODUCTION	INSIGNIFICANT	
C. WILDLIFE HABITAT	0	0
D. MINING	0	0
E. CHANGE IN TIMBER HARVEST COSTS	0	0
F. RECREATION POTENTIAL	-	\$356,000 ^{3/}
SUBTOTAL	\$57,250	\$356,000
GRAND TOTAL NET GAIN		\$298,750

^{1/} THESE COSTS ARE NOT REIMBURSABLE AND WILL BE FINANCED BY THE FOREST SERVICE FROM ITS REGULAR APPROPRIATIONS. TO FACILITATE ADEQUATE DETERMINATION OF PROJECT BENEFITS AND FEASIBILITY, LOSSES AND GAINS ARE PRESENTED TO COMPLETE THE PICTURE OF TOTAL IMPACT.

^{2/} INCREASED ROAD MAINTENANCE COSTS MAY BE FINANCED BY A PUBLIC ROAD AGENCY OR THE FOREST SERVICE IN ACCORDANCE WITH AGREEMENTS DEVELOPED AFTER CONSTRUCTION.

^{3/} THIS VALUE INCLUDES ONLY THOSE RECREATIONAL BENEFITS WHICH ARE SUBJECT TO MONETARY EVALUATION. IT DOES NOT INCLUDE ADDITIONAL AESTHETIC AND INDIRECT BENEFITS.

IMPACTS ON LOCAL FOREST-BASED ECONOMY AND ON NON-FEDERAL FOREST LANDS

THE EFFECTS OF PROJECT CONSTRUCTION AND OPERATION UPON THE FOREST RESOURCES OF THE NON-FEDERAL LANDS IN THE CLARK NATIONAL FOREST WILL BE NEGLIGIBLE. HOWEVER, AFTER CONSTRUCTION, THE ADDITIONAL PUBLIC USE WILL INCREASE THE FIRE POTENTIAL. THE AREA WEST OF HUIZZAH AND NORTH OF DRY FORK IS PREDOMINATELY PRIVATE LAND. IT IS PROTECTED BY MISSOURI CONSERVATION COMMISSION UNDER PROVISIONS OF THE COOPERATIVE AGREEMENT BETWEEN THE TWO AGENCIES. AN INTENSIFICATION OF FIRE PREVENTION SERVICES IN THIS PROTECTION AREA WILL BE REQUIRED FOLLOWING PROJECT CONSTRUCTION.

THE AREA REDEVELOPMENT ACT PROGRAM IS HAVING A DIRECT EFFECT ON THAT PORTION OF THE MERAMEC BASIN SITUATED WITHIN THE BOUNDARIES OF THE CLARK NATIONAL FOREST. THIS PROGRAM IS INVOLVED WITH THE DEVELOPMENT OF ALL RESOURCES. FORESTRY AND MULTIPLE-USE MANAGEMENT ARE OF PARTICULAR SIGNIFICANCE AS FOREST LAND MAKES UP A LARGE PERCENTAGE OF THE TOTAL. THE PROGRAM HAS BENEFICIAL EFFECTS TO BOTH PRIVATE AND PUBLIC FOREST LAND.

WITH THE EXCEPTION OF CRAWFORD, ALL THE COUNTIES WITHIN THE FOREST BOUNDARY HAVE QUALIFIED UNDER ARA. THESE ARE WASHINGTON, IRON, REYNOLDS AND DENT. THE FIRST TWO OF THESE ARE CLASSIFIED UNDER THE ACT AS 5A COUNTIES WHILE THE LAST TWO ARE 5B.

THE 5A COUNTIES (WASHINGTON AND IRON) ARE COVERED BY A SINGLE FIVE-COUNTY OVERALL ECONOMIC DEVELOPMENT PROGRAM PLAN WHICH ALSO INCLUDES THREE ADJOINING COUNTIES WHICH ARE SITUATED ENTIRELY OUTSIDE THE MERAMEC BASIN. SEPARATE OEDP'S WITH RURAL AREAS DEVELOPMENT APPROVAL COVER THE TWO 5B COUNTIES.

THE NET EFFECT OF THE RAD EFFORTS IN BOTH 5A AND 5B COUNTIES HAS ALREADY HAD A SIGNIFICANT BEARING ON THE REDEVELOPMENT OF THE LANDS WITHIN THE MERAMEC BASIN. COMMITTEES OF LOCAL CITIZENS HAVE ANALYZED THE RESOURCE AND ECONOMIC PROBLEMS AND HAVE PUT INTO EFFECT PROGRAMS TO COVER THEM. THESE PROGRAMS COVER SUCH FIELDS AS INDUSTRY, HEALTH, EDUCATION, COMMUNICATIONS, ROADS AND HIGHWAYS, PUBLIC FACILITIES, DAIRY, FORESTRY, TOURISM, RECREATION, LIVESTOCK, AGRICULTURE AND CONSERVATION.

THE ACCELERATED PUBLIC WORKS PROGRAM UNDER THE AUTHORITY OF THE AREA REDEVELOPMENT ACT, DIRECTED BY THE DEPARTMENT OF COMMERCE, HAS MADE FUNDS AVAILABLE TO THE CLARK NATIONAL FOREST FOR IMPROVING THE MULTIPLE USE RESOURCES OF THE FOREST. THE WORK IN THE MERAMEC BASIN ACCOMPLISHED UNDER THIS ARRANGEMENT HAS CONSISTED OF RECREATION IMPROVEMENTS, WILDLIFE HABITAT DEVELOPMENT, TIMBER STAND IMPROVEMENT, REFORESTATION, BUILDING CONSTRUCTION, EROSION CONTROL AND FIREWAY CONSTRUCTION.

SUMMARY AND RECOMMENDATIONS

THE PROPOSED MERAMEC BASIN PROJECT INCLUDES 619 SQUARE MILES OF THE CLARK NATIONAL FOREST. IN THIS AREA, WHICH APPROXIMATES ONE-SIXTH OF THE BASIN, 48% OF THE LANDS ARE NATIONAL FOREST AND 52% ARE PRIVATELY OWNED. FIVE PROPOSED RESERVOIRS ARE WITHIN THE NATIONAL FOREST BOUNDARY, AND THE MERAMEC PARK RESERVOIR IS PARTIALLY WITHIN THE NATIONAL FOREST. TWO OTHER RESERVOIRS ARE NEARBY. THE RESERVOIRS WILL FLOOD 8.5 MILES OF SIX FOREST SERVICE ROADS. THESE ROADS ARE IMPORTANT UNITS OF THE NATIONAL FOREST TRANSPORTATION SYSTEM AND MUST BE RELOCATED AND RESTORED TO PROVIDE THE SAME LEVEL OF SERVICE TO THE NATIONAL FORESTS AS IS NOW AVAILABLE.

ALL THE COUNTIES WITHIN THE FOREST BOUNDARY, EXCEPT CRAWFORD, HAVE QUALIFIED FOR ASSISTANCE UNDER AREA REDEVELOPMENT ACT OF MAY 1, 1961. OVERALL ECONOMIC DEVELOPMENT PROGRAMS WHICH HAVE RURAL AREA DEVELOPMENT APPROVAL COVER THESE COUNTIES AND ARE NOW IN EFFECT. PRESENTLY THE ACCELERATED PUBLIC WORKS PROGRAM HAS MADE FUNDS AVAILABLE FOR LOCAL EMPLOYMENT FOR RESOURCE IMPROVEMENT IN THE FIELD OF RECREATION, WILDLIFE, TIMBER AND WATER MANAGEMENT. THE CONTINUED REHABILITATION, DEVELOPMENT AND UTILIZATION OF THE RENEWABLE SURFACE RESOURCES WITHIN THE NATIONAL FOREST WILL FURTHER INCREASE THE EMPLOYMENT AND ADD TO THE ECONOMY OF THE AREA. THE PROPOSED MERAMEC PROJECT WILL PROVIDE MANY OPPORTUNITIES FOR ADDITIONAL EMPLOYMENT AND DEVELOPMENT OF THESE RESOURCES.

THE RESERVOIRS AND ADJOINING AREA WILL PROVIDE EXCELLENT OPPORTUNITIES FOR BOATING, FISHING, PICNICKING, CAMPING AND SWIMMING IN AN AREA WHERE SUCH OPPORTUNITIES ARE RELATIVELY LIMITED. FUTURE RECREATIONAL USE RESULTING FROM PROJECT CONSTRUCTION IS EXPECTED TO AMOUNT TO 222,500 VISITS ANNUALLY ON NATIONAL FOREST LANDS. ADDITIONAL FACILITIES AND SERVICES WILL BE NEEDED TO SAFEGUARD PUBLIC HEALTH AND SAFETY, PREVENT WATER SUPPLY POLLUTION, PROTECT PUBLIC PROPERTY AND PROVIDE RECREATIONAL OPPORTUNITIES FOR PEOPLE ATTRACTED TO THE PROJECTS.

THE RESERVOIR CONSTRUCTION GIVES THE FOREST SERVICE JUSTIFIABLE CONCERN AND INTEREST REGARDING THE CHARACTER OF USE AND DEVELOPMENT THAT WILL TAKE PLACE AROUND THE RESERVOIRS. THE OWNERSHIP OF THESE LANDS, WHETHER PRIVATE OR PUBLIC, AND THE MANNER IN WHICH THEY ARE ADMINISTERED, WILL AFFECT FUTURE USE, PROTECTION AND MANAGEMENT OF THE NATIONAL FOREST. THERE IS ALSO JUSTIFIABLE CONCERN REGARDING ANY FUTURE ACQUISITION OF WILD LANDS FOR NATIONAL FOREST PURPOSES BECAUSE OF INFLATIONARY VALUES RESULTING FROM THE RESERVOIRS. CONSTRUCTION AND OPERATION OF THE PROJECT INSTALLATION WILL HAVE SIGNIFICANT EFFECTS UPON NATIONAL FOREST ADMINISTRATION, MANAGEMENT AND PROTECTION. THEREFORE, IT IS RECOMMENDED THAT:

1. FACILITIES AND SERVICES INUNDATED OR IMPAIRED AS A RESULT OF PROJECT CONSTRUCTION BE REPLACED AT PROJECT COST SO THAT A LEVEL OF SERVICE EQUIVALENT TO THAT EXISTING PRIOR TO CONSTRUCTION WILL BE PROVIDED WHEN THE PROJECT IS COMPLETED. THIS PHASE OF THE PRO-

GRAM SHOULD BE DONE IN ADVANCE OR CONCURRENTLY WITH PROJECT CONSTRUCTION SO THAT THERE WILL BE LITTLE OR NO INTERRUPTION IN FOREST SERVICE ADMINISTRATION AND PUBLIC USE. FOR THOSE IMPROVEMENTS WHICH WILL BE ON NATIONAL FOREST LAND OR WILL NEED TO BE INSTALLED ON THE OTHER LAND TO REPLACE EXISTING NATIONAL FOREST FACILITIES AND SERVICES, IT IS ESSENTIAL THAT THE FOREST SERVICE AND THE CORPS OF ENGINEERS AGREE ON LOCATION, STANDARD AND DESIGN BEFORE CONSTRUCTION IS BEGUN.

2. NATIONAL FOREST LAND ADJACENT TO THE RESERVOIR SITES SHOULD BE RETAINED IN UNENCUMBERED CONDITION UNTIL FUTURE NEED FOR THESE LANDS FOR PUBLIC RECREATION OR OTHER PUBLIC PURPOSES CAN BE DETERMINED. THE ADJACENT NON-FEDERAL LANDS WHICH WILL BE SUITABLE FOR PUBLIC RECREATION OR OTHER PUBLIC USES, OR WHICH WILL CONTROL PUBLIC ACCESS TO THE RESERVOIR, SHOULD BE ACQUIRED BY THE PROJECT CONSTRUCTION AGENCY.

LANDS NEEDED FOR RECREATION OR OTHER PUBLIC PURPOSES SHOULD BE RETAINED IN PUBLIC OWNERSHIP AND DEVELOPED BY A PUBLIC AGENCY OR AGENCIES SUBJECT TO THEIR CONTINUED AVAILABILITY FOR FLOOD CONTROL PURPOSES.

THE AUTHORIZING LEGISLATION FOR THE PROJECT PROVIDES THAT ALL LANDS WITHIN THE EXTERIOR BOUNDARY OF THE NATIONAL FOREST, ACQUIRED BY THE UNITED STATES FOR OR IN CONNECTION WITH THE MERAMEC RIVER BASIN PROJECT, SHALL BECOME NATIONAL FOREST LAND SUBJECT TO AVAILABILITY FOR FLOOD CONTROL PURPOSES.

ALL NATIONAL FOREST LAND ADJACENT TO THE RESERVOIR SITES WILL BE ADMINISTERED, DEVELOPED AND MANAGED BY THE FOREST SERVICE SUBJECT TO THEIR AVAILABILITY FOR FLOOD CONTROL PURPOSES.

3. THE FOREST SERVICE WILL CONSULT WITH THE CORPS OF ENGINEERS IN DEVELOPING OVERALL PLANS FOR PROTECTING AND ADMINISTERING PUBLIC RECREATION USE AND CONSTRUCTING RECREATION FACILITIES ON UNITED STATES LANDS WITHIN THE NATIONAL FOREST BOUNDARY IN ACCORDANCE WITH SECTION 8 OF THE MEMORANDUM OF AGREEMENT BETWEEN THE SECRETARY OF WAR AND SECRETARY OF AGRICULTURE DATED DECEMBER 16, 1946.
4. RECREATIONAL FACILITIES, SUCH AS CAMPGROUNDS, PICNIC GROUNDS AND OTHER RECREATIONAL SITES, SHOULD BE PLANNED AND DEVELOPED AT THE RESERVOIRS AND ON ADJACENT AREAS TO SERVE THE PEOPLE WHO WILL BE ATTRACTED TO THE AREA. SUCH FACILITIES AND DEVELOPMENTS SHOULD BE THOSE NECESSARY FOR ADEQUATE PROTECTION OF PUBLIC HEALTH AND SAFETY, TO PREVENT POLLUTION OF WATER SUPPLIES, TO PROVIDE FOR PUBLIC ENJOYMENT AND TO SAFEGUARD PUBLIC PROPERTY, INCLUDING NATIONAL FOREST AND OTHER RESOURCE VALUES.

IN THE INTEREST OF PUBLIC HEALTH, WELFARE, SAFETY OR CONVENIENCE, PLANS FOR, AND THE OPERATION OF THE RESERVOIRS, SHOULD PROVIDE FOR THE REGULATION OF BOATING, KINDS OF BOATS, SIZE OF MOTORS,

ZONING RESTRICTIONS, POLLUTION AND SANITATION.

5. PLANS FOR AND OPERATION OF THE PROJECTS SHOULD HAVE PROVISIONS FOR TEMPERATURE, COMPOSITION AND FLUCTUATION CONTROLS WHICH ARE NEEDED FOR THE PROTECTION AND USE OF THE STREAMS BELOW THE DAMS FOR RECREATION AND FISHING.
6. THE COST OF PROVIDING INTENSIFIED FIRE PROTECTION AND INCREASED ROAD MAINTENANCE DURING CONSTRUCTION PERIODS SHOULD BE INCLUDED AS A PART OF THE PROJECT COSTS.
7. IN ORDER TO INSURE AND PROTECT THE UNITED STATES FROM DAMAGES OF FOREST FIRES ON NATIONAL FOREST LANDS, CONSTRUCTION CONTRACTS SHOULD CONTAIN AN APPROPRIATE FIRE LIABILITY CLAUSE, AND THE CONSTRUCTION AGENCY SHOULD REQUIRE CONTRACTORS TO FURNISH BONDS COVERING LOSSES AND SUPPRESSION COSTS OF FOREST FIRES CAUSED BY CONTRACTORS OR THEIR EMPLOYEES IN THE COURSE OF PROJECT INSTALLATION.
8. THE NUMBER OF VISITORS EXPECTED AFTER CONSTRUCTION WILL TAX PRESENT NATIONAL FOREST LANDS TO GIVE THE PUBLIC THE SERVICE EXPECTED. IN ORDER TO PROVIDE FOR THE MAXIMUM PUBLIC SERVICE, SUCH AS PUBLIC HUNTING AREAS, ACCESS TO FISHING STREAMS AND SCENIC ATTRACTIONS, AS WELL AS GOOD WATERSHED CONDITIONS AND TIMBER PRODUCTION, THE NATIONAL FOREST ACQUISITION PROGRAM SHOULD BE ACTIVATED TO PROCURE THE NEEDED LANDS PRIOR TO THE INFLATION CREATED BY THE PUBLIC CONSTRUCTED RESERVOIRS. PRIORITY SHOULD BE GIVEN TO LANDS WHICH ARE, OR MAY BE, A SOURCE OF SEDIMENTATION, OR ARE NEEDED FOR MAXIMUM ENHANCEMENT OF RECREATION (INCLUDING SCENERY) OR FOR WILDLIFE HABITAT DEVELOPMENT.
9. PROVISION SHOULD BE MADE FOR ACQUISITION OF PROJECT-REQUIRED LANDS TO INCLUDE ALL THE LANDS BETWEEN THE RESERVOIR FLOOD POOL AND PRESENT NATIONAL FOREST LANDS. THIS WOULD PROVIDE PUBLIC ACCESS TO NATIONAL FOREST LANDS FOR ADEQUATE ZONE CONTROL FOR FOREST-TYPE RECREATION.
10. PROJECT LAND SHOULD BE ACQUIRED BEFORE PROJECT IS AUTHORIZED FOR CONSTRUCTION. ACQUISITION CAN BE HANDLED BY THE FOREST SERVICE UNDER EXISTING AUTHORITIES WITHIN AN EXTENDED NATIONAL FOREST BOUNDARY AS A COOPERATIVE PROGRAM WITH THE CORPS OF ENGINEERS.
11. THIS APPRAISAL OF IMPACTS WILL BE REVISED IN THE EVENT THAT FEATURES OF THE PROPOSED RESERVOIR SYSTEM SUBSTANTIALLY CHANGE AS A RESULT OF PRESENT STUDIES AND PROJECT PLANNING.
12. THE OUTSTANDING MINERAL RIGHTS ON NATIONAL FOREST LANDS WHICH WILL SERIOUSLY AFFECT THE PROJECT PURPOSES SHOULD BE ACQUIRED.
13. A FEASIBILITY STUDY BE MADE TO CONSIDER EXTENSION OF THE NATIONAL FOREST BOUNDARY NORTH ALONG THE EAST SHORE OF MERAMEC PARK RESERVOIR TO FACILITATE MULTIPLE USE MANAGEMENT AND PROTECTION AND PUBLIC USE OF FOREST LANDS.

APPENDIX

PRELIMINARY DATA

RESERVOIRS SELECTED FOR DETAILED ENGINEERING AND ECONOMIC ANALYSIS

MERAMEC BASIN IN AND NEAR CLARK NATIONAL FOREST

DAM	STREAM	DRAINAGE AREA - SQ. MILE.	APPROXIMATE DAM HEIGHT	APPROXIMATE TOTAL STORAGE ACRE-FOOT	APPROXIMATE AREA - ACRES NORMAL POOL	APPROXIMATE SHORELINE NORMAL POOL MILES	FLOOD CONTROL POOL ELEVATION	NORMAL POOL ELEVATION	FLOOD CONTROL POOL (ACRES SURFACE AREA)	COUNTY
MERAMEC PARK	MERAMEC RIVER	1,500	175	1,000,000	12,800 140*	190 3*	701	667	3,635*	FRANKLIN CRAWFORD
I-14	HUZZAH CR.	112	90	37,000	510*	10*	881	850	1,200*	CRAWFORD
I-15A	COURTOIS CREEK	122	75	40,000	660*	12*	834	808	1,664*	WASHINGTON
I-26	WEST FORK HUZZAH	27	80	10,000	520*	15*	1,026	1,015	1,155	DENT
H-10	LOST CREEK	5	50	2,000	50*	1*	978	960	72*	WASHINGTON
H-25	BIG RIVER	14	75	5,000	90*	2*	1,062	1,036	215*	IRON
TOTALS	-	1,780	-	1,094,000	1,970*	43* $\frac{1}{2}$	-	-	7,941*	

* INSIDE NATIONAL FOREST BOUNDARY

$\frac{1}{2}$ TOTAL SHORELINE MILES ENTIRE MERAMEC BASIN - 750.

ACREAGE LANDS INVOLVED IN PROJECT DEVELOPMENT
CLARK NATIONAL FOREST

RESERVOIR	PRIVATE LANDS IN RESERVOIR AREA *	PRIVATE LANDS BETWEEN RESERVOIR AREA AND NATIONAL FOREST LANDS**	TOTAL PRIVATE LANDS	TOTAL N.F. LAND INUNDATED
#17	3590	5730	9320	55
1-14	1910	2400	4310	28
1-15A	1730	1860	3590	54
1-26	870	1520	2390	142
H-10	220	290	510	0
H-25	<u>440</u>	<u>1050</u>	<u>1490</u>	<u>8</u>
TOTALS	8760	12850	21610	287

*INCLUDES 300' ACCESS STRIP.

**NEEDED TO PROVIDE CONTINUOUS PUBLIC OWNERSHIP.

ACREAGE OF PRIVATE LANDS BETWEEN RESERVOIR
AREA AND NATIONAL FOREST LAND BY LAND USE

RESERVOIR	LAND USE			
	CULTIVATION	PASTURE	TIMBER	TOTAL
#17	290	204	5236	5730
1-14	112	375	1913	2400
1-15A	93	167	1600	1860
1-26	80	246	1194	1520
H-10	32	44	214	290
H-25	<u>42</u>	<u>137</u>	<u>871</u>	<u>1050</u>
TOTALS	649	1173	11028	12850

91° 30'

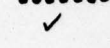
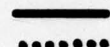
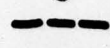
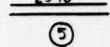
20'

10'

CLARK NATIONAL FOREST
MERAMEC RIVER BASIN PROJECT
IMPACT COMPOSITE MAP

LEGEND

- Proposed Reservoir
- Proposed Road
- Proposed Recreation Site
- Individual Watershed Boundary
- Meramec Basin Watershed Boundary
- Individual Project Impact Boundary
- 99 Year Mineral Reservation--Renewable
at 20 year intervals up to 200 years.
May be mined by any known method.



T.37N.

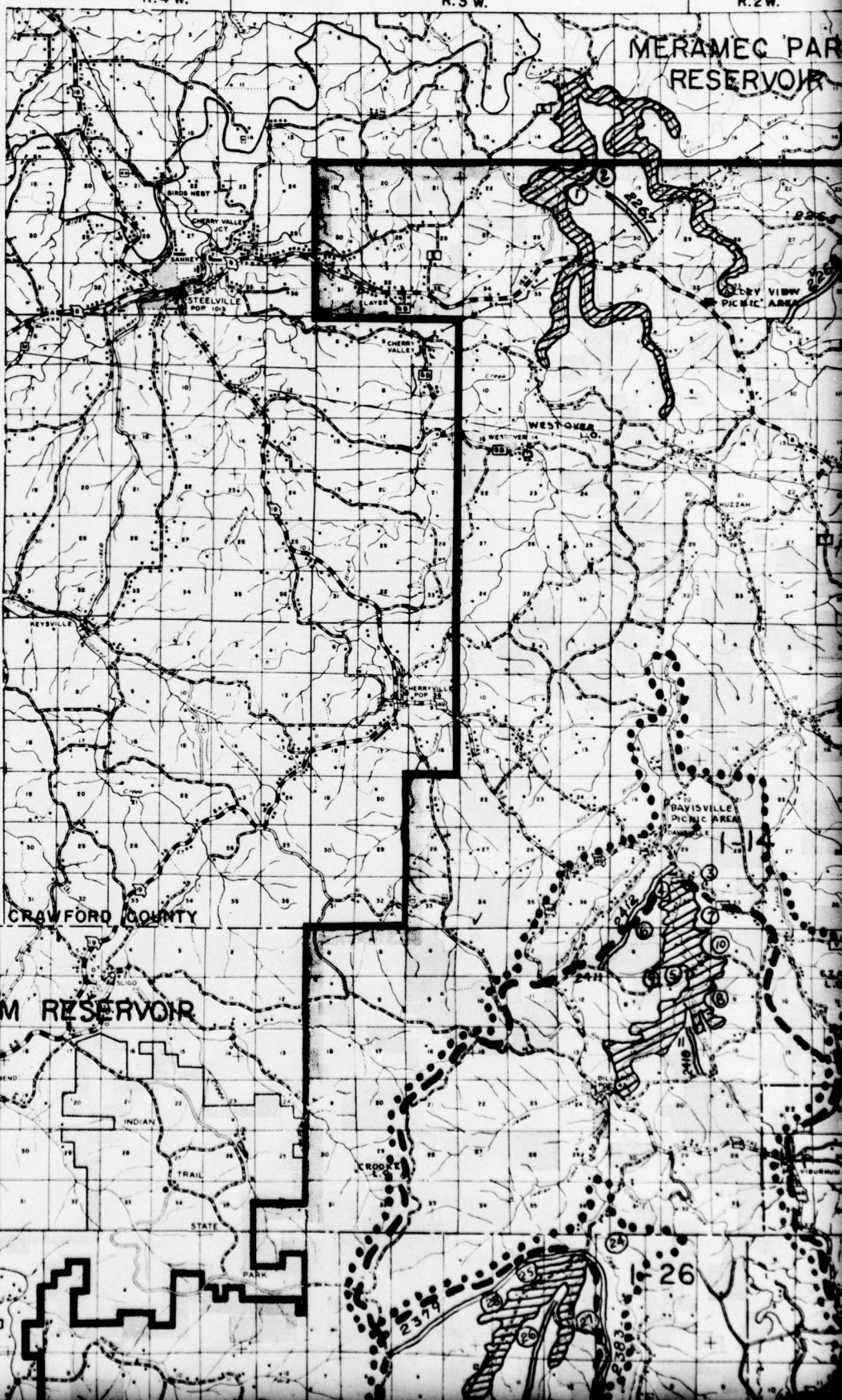
T.36N.

R.5W.

R.4W.

R.3W.

R.2W.

MERAMEC PARK
RESERVOIR

DENT COUNTY

CRAWFORD COUNTY

SALEM RESERVOIR

T.35N.

40'

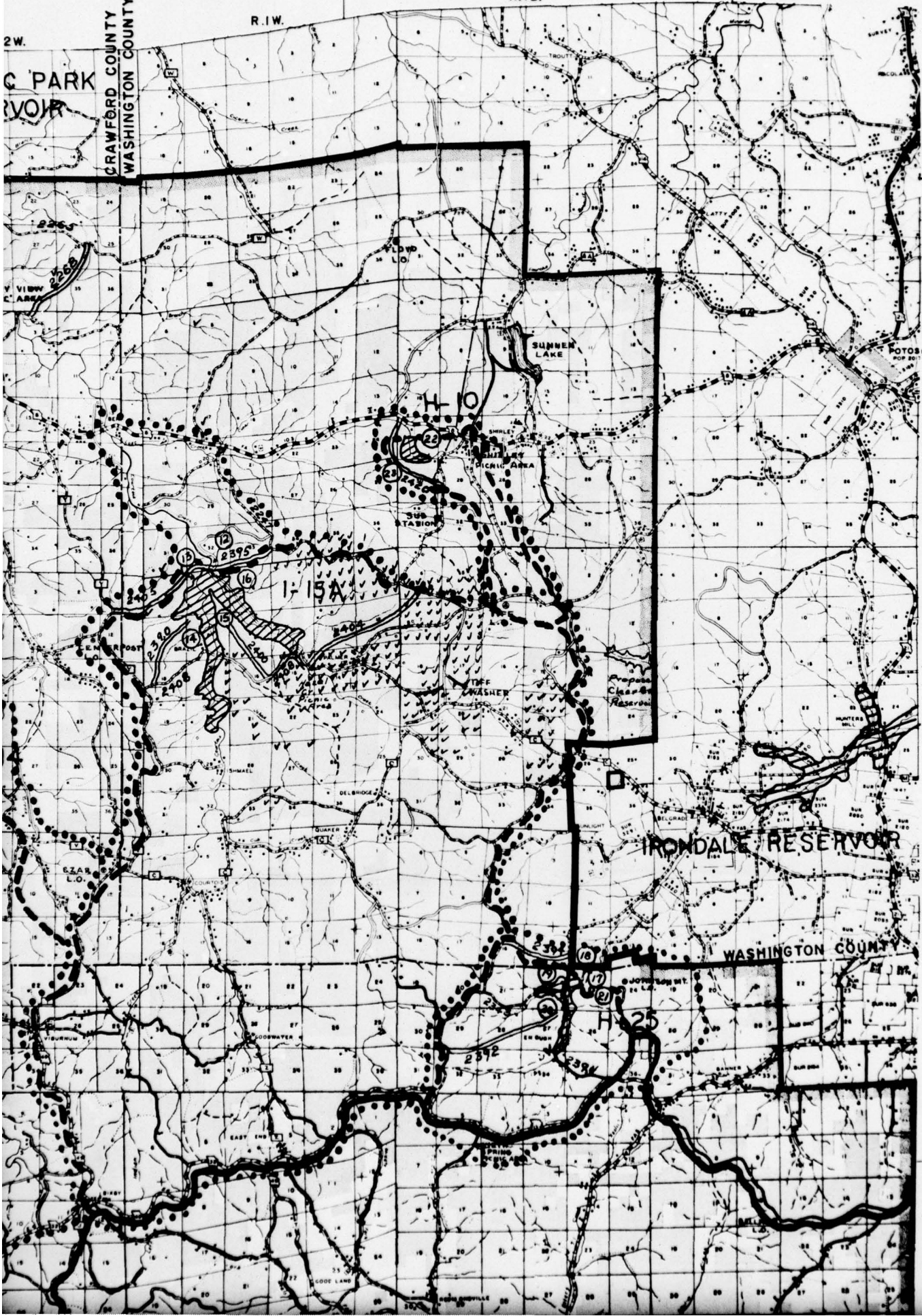
I-26

2W.
C PARK
VOIR
CRAWFORD COUNTY
WASHINGTON COUNTY

R.1E.

R.2E.

2



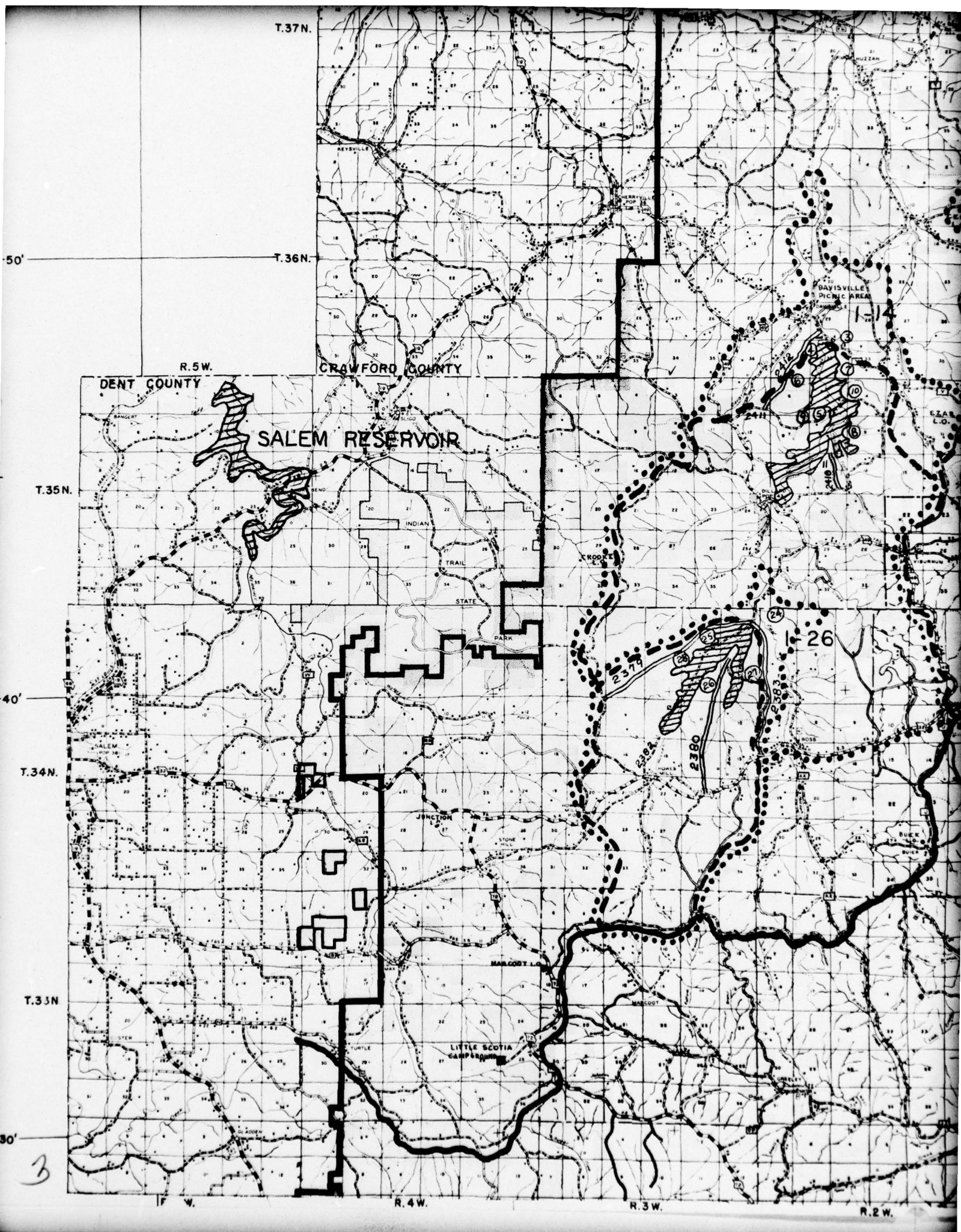
38°00'

50'

T.35N.

40'

T.34N.



T.37N.

50'

T.36N.

R.5W.

CRAWFORD COUNTY

DENT COUNTY

SALEM RESERVOIR

T.35N.

40'

T.34N.

T.33N.

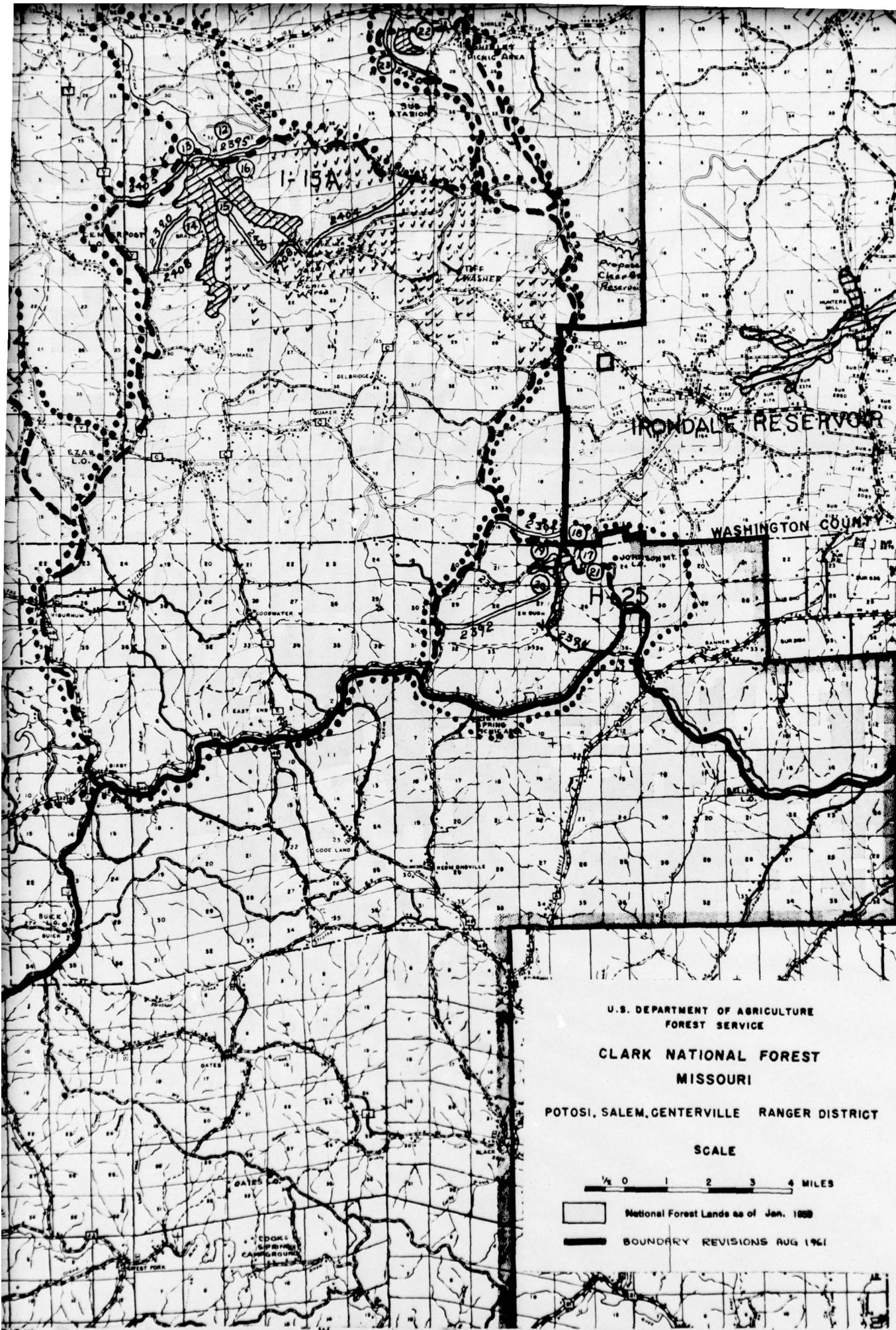
30'

R.5W.

R.4W.

R.3W.

R.2W.



U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

CLARK NATIONAL FOREST
MISSOURI

33N.

POTOSI, SALEM, CENTERVILLE RANGER DISTRICT

SCALE

1/4 0 1 2 3 4 MILES



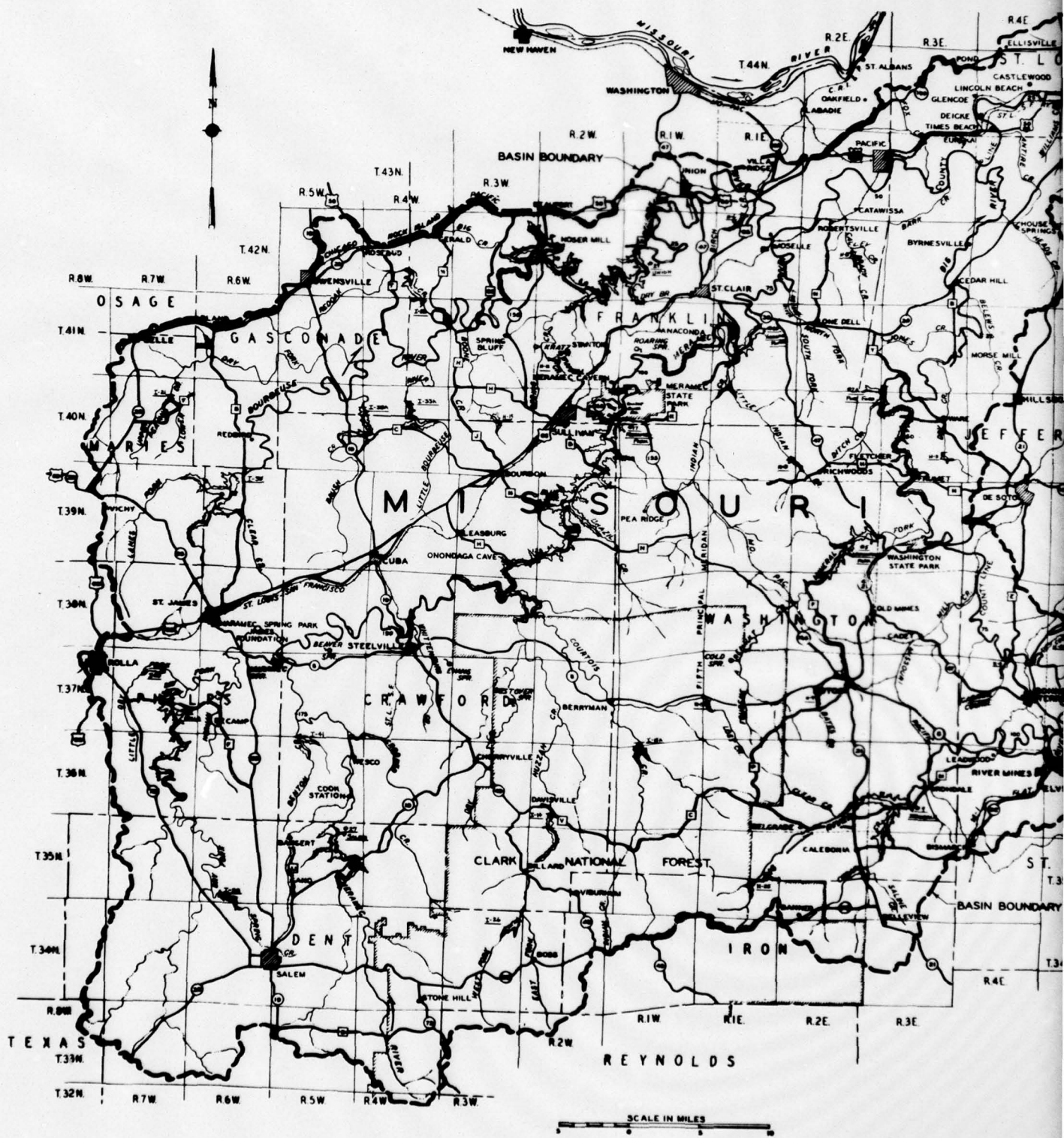
National Forest Lands as of Jan. 1909

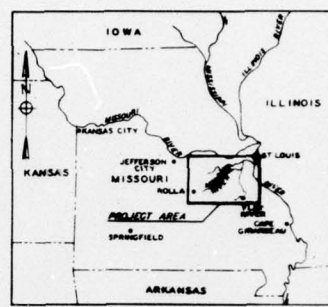
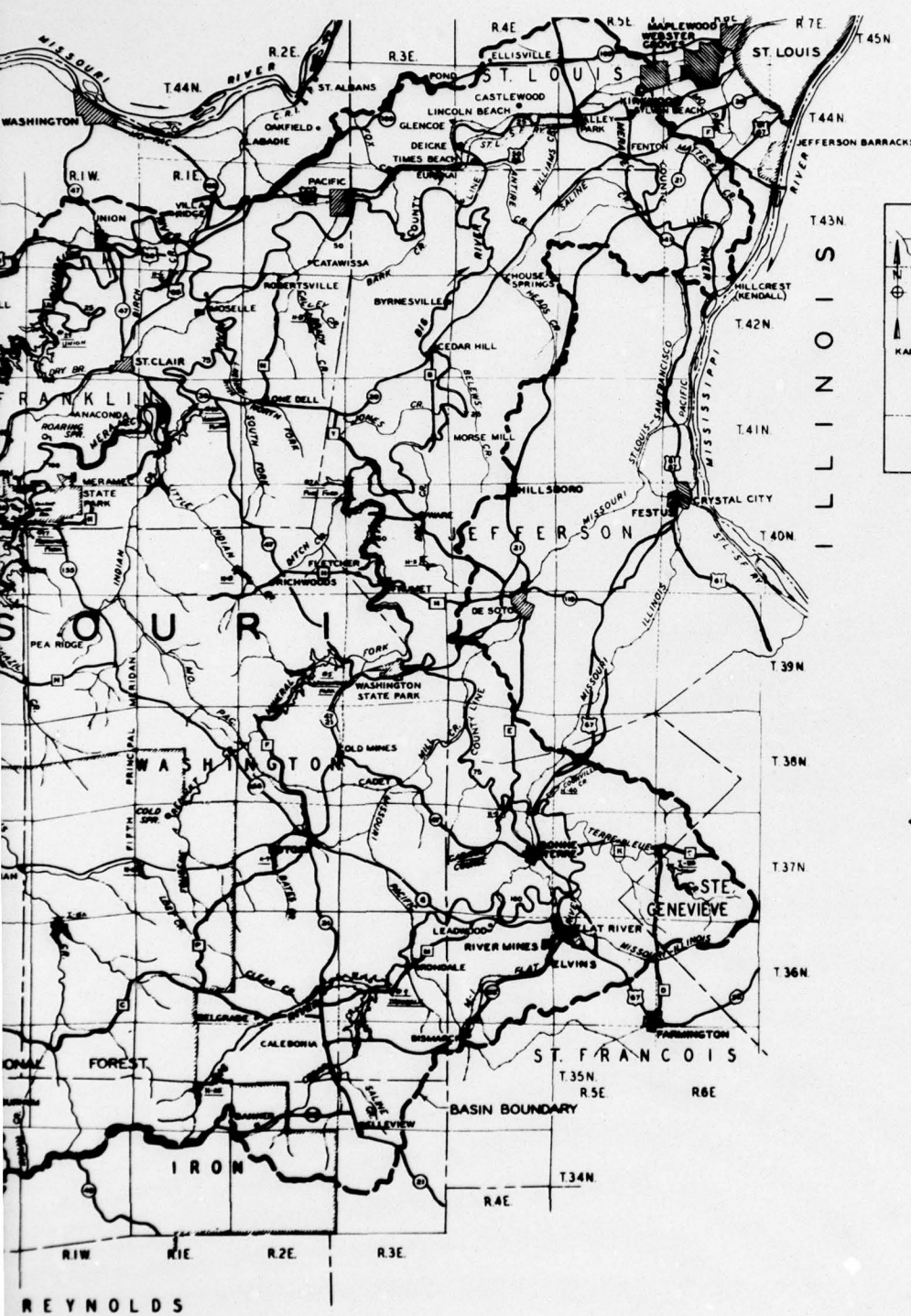


BOUNDARY REVISIONS AUG 1961

30'

4



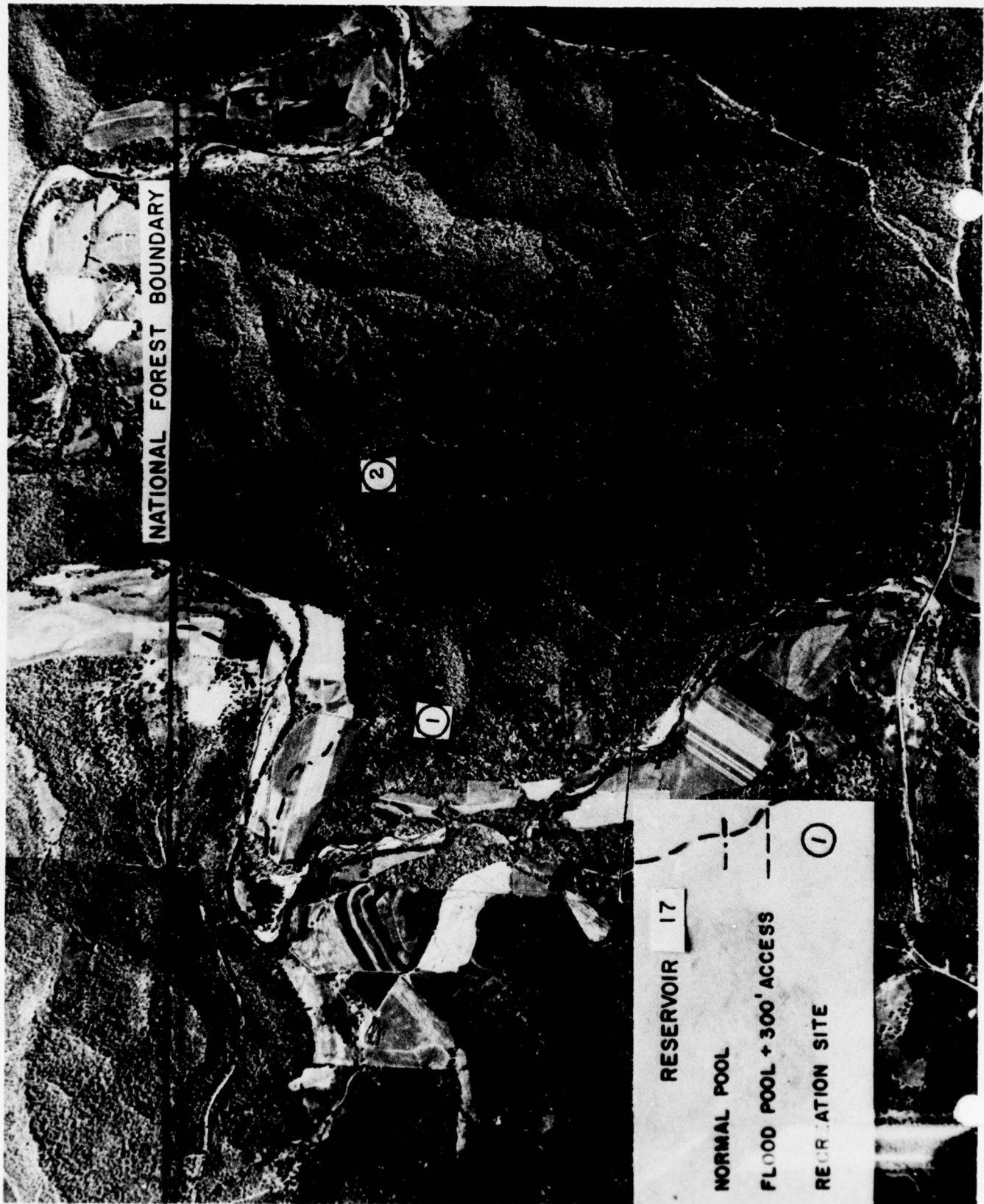


- LEGEND**
- LEVIES
 - MAJOR RESERVOIR
 - INTERMEDIATE RESERVOIR
 - HEADWATER RESERVOIR
 - U.S. ROUTE MARKER
 - STATE ROUTE MARKER
 - SUPPLEMENTARY ROUTE MARKER
 - BASIN BOUNDARY

NOTE: NORMAL POOL ELEVATIONS SHOWN
LIMITS AND DETAILS ARE TENTATIVE



2



NATIONAL FOREST BOUNDARY

2

1

RESERVOIR 17

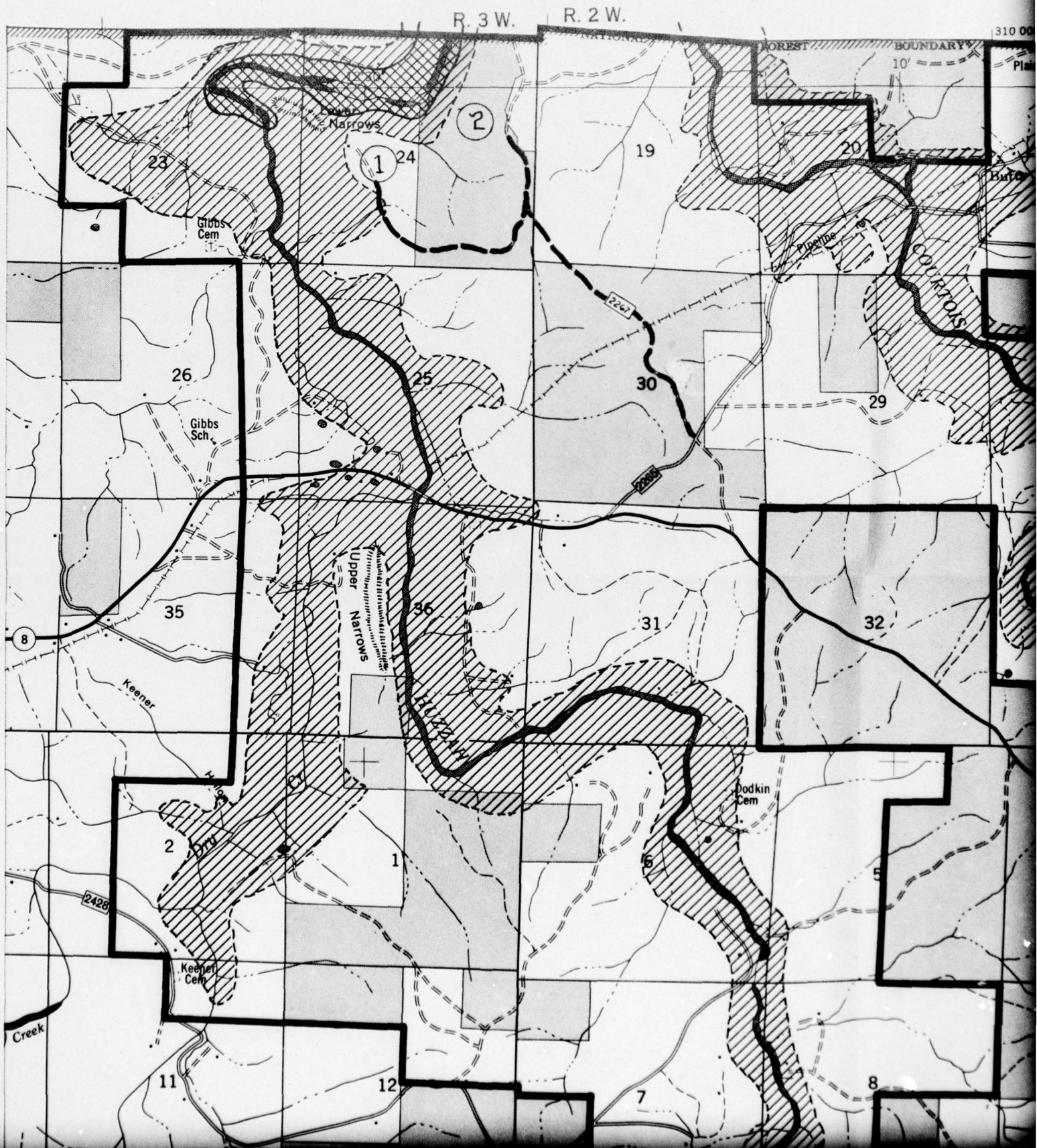
NORMAL POOL

FLOOD POOL + 300' ACCESS

RECREATION SITE

1

1

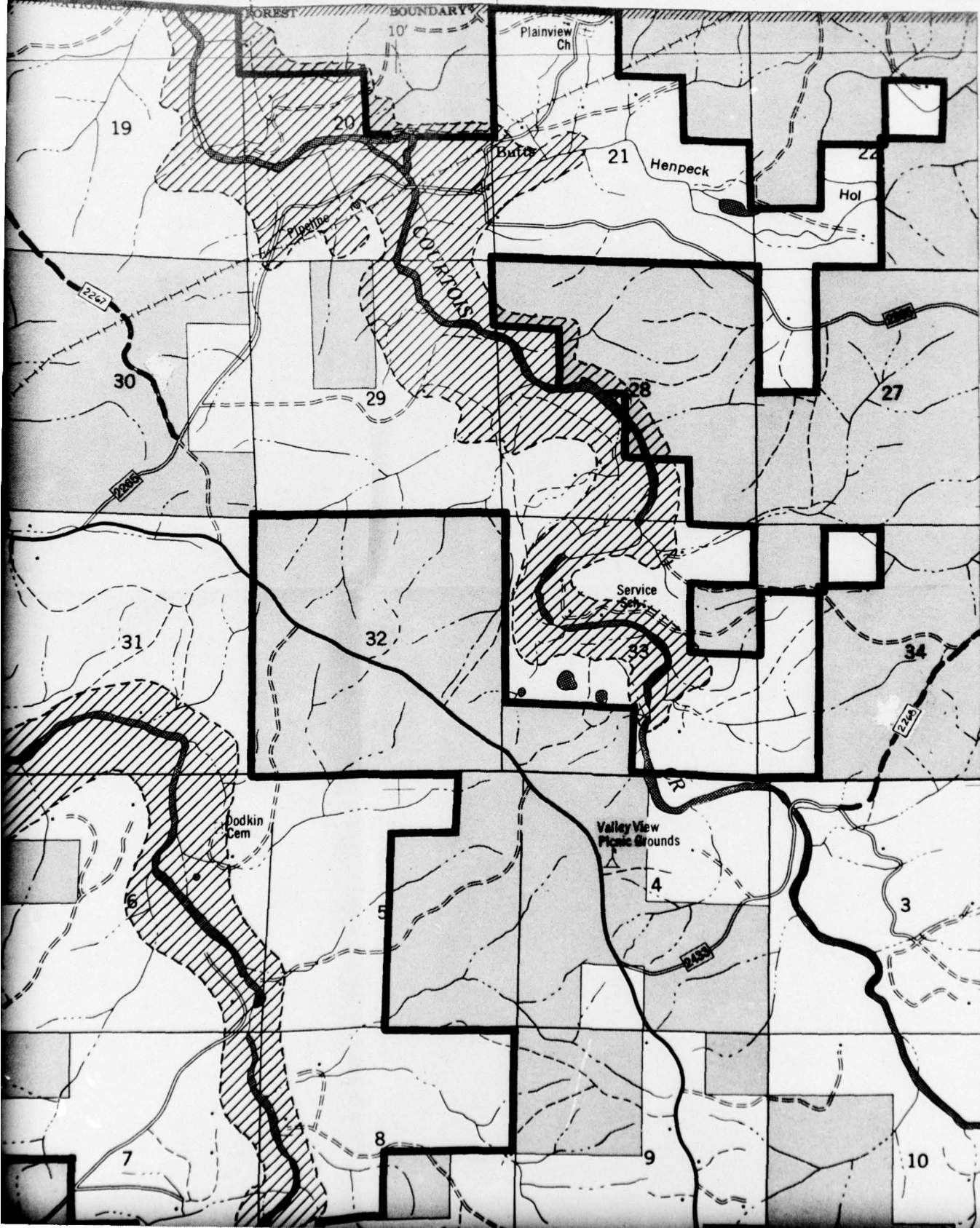


2

R. 2 W.

310 000 FEET

91°07'30"



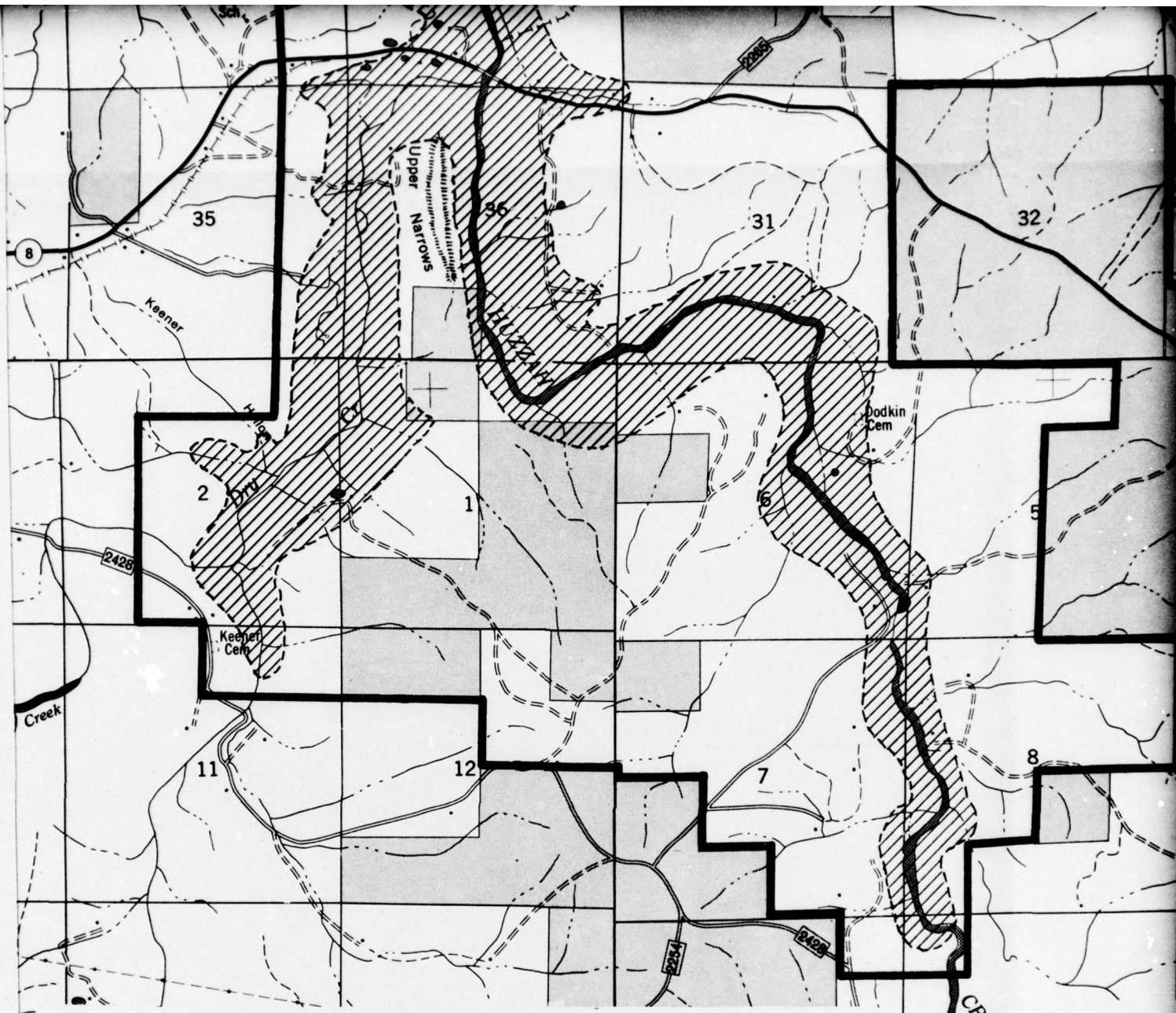
38°00'

780 000
FEET

T. 38 N.

57'30"

T. 37 N.



PUBLIC USE RECREATION PROJECTION CHART - #17

SITE NO.	NAME	TYPE	Development-Units or Capacity					
			Impact 1970		Ultimate		TOTAL	
			P	C	P	C	P	C
1	Lower Narrows	Picnic	23	-	69	-	92	-
2	Boundary	Camp	-	10	-	35	-	45
	TOTALS		23	10	69	35	92	45

BOUNDARY OF
And
FLOOD CONTR
NORMAL POOL
PROPOSED RO
RECREATION
ACQUISITION

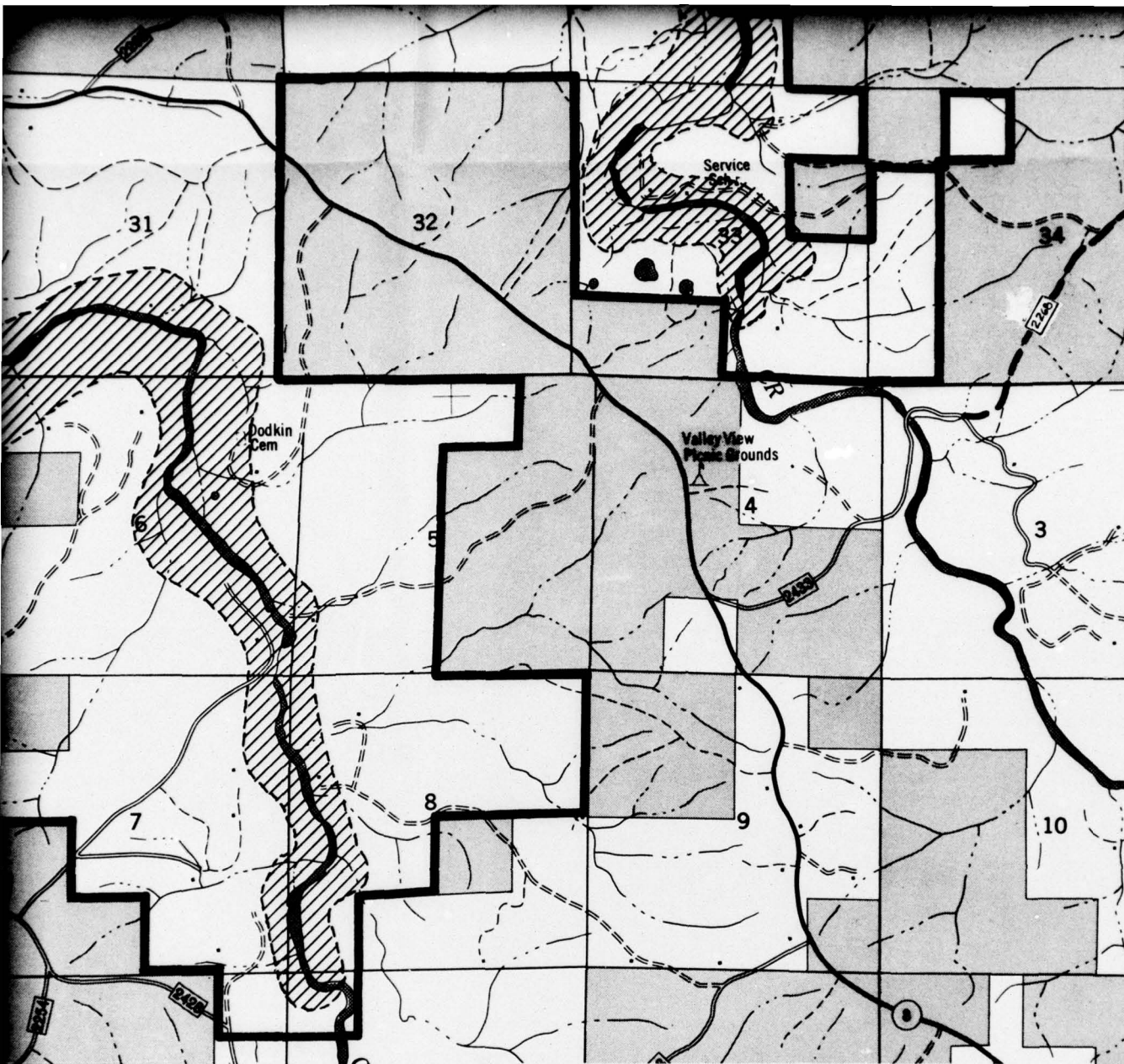
3

780 000
FEET

T. 38 N.

57'30"

T. 37 N.

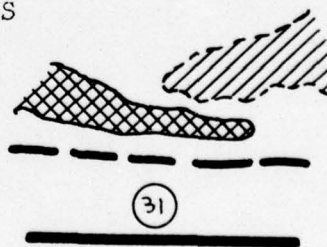


#17

Units or Capacity		TOTAL	
Estimate		P	C
P	C	P	C
9	-	92	-
-	35	-	45
9	35	92	45

Legend

BOUNDARY OF 300' ACCESS
And
FLOOD CONTROL POOL
NORMAL POOL
PROPOSED ROADS
RECREATION SITE
ACQUISITION BOUNDARY



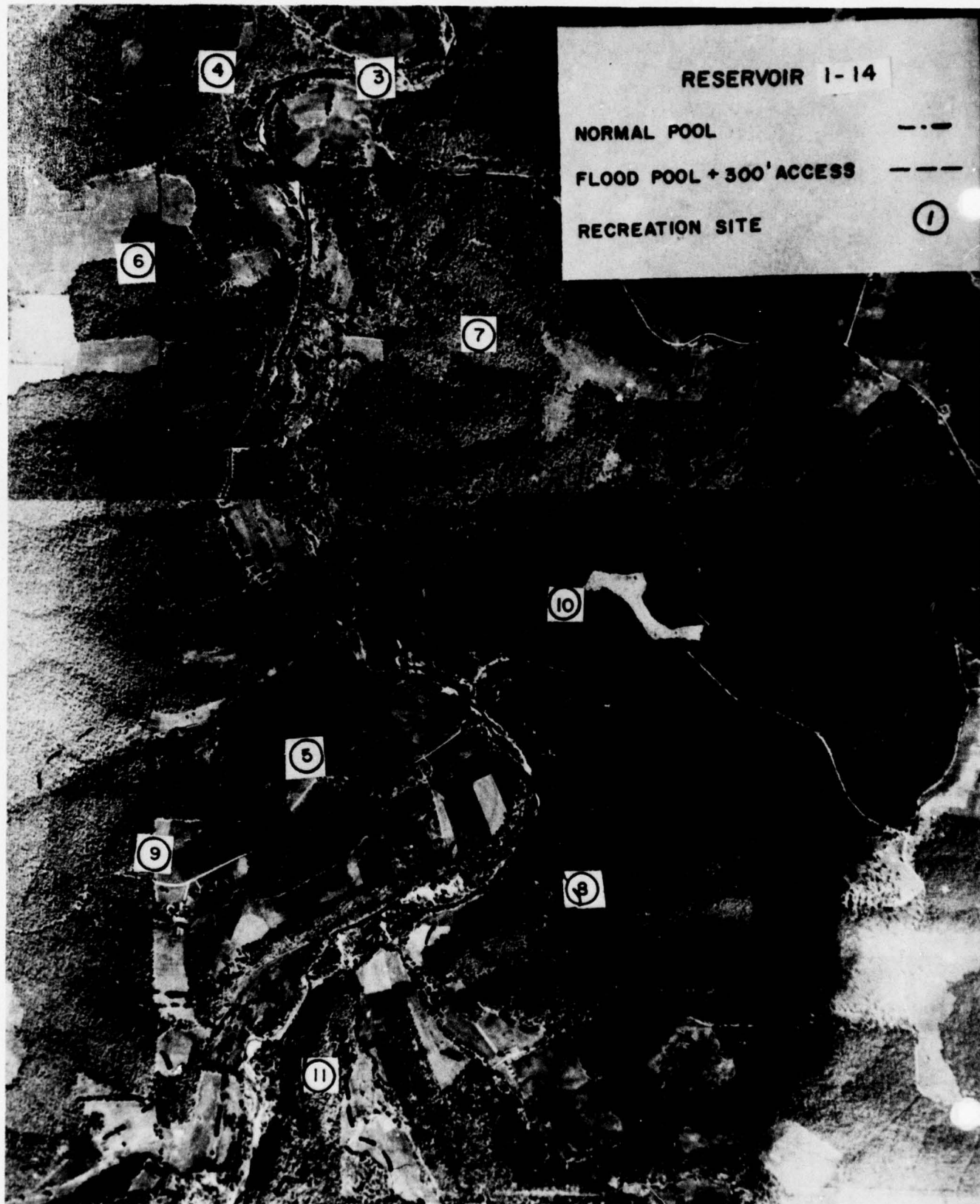
55'

19'

20'

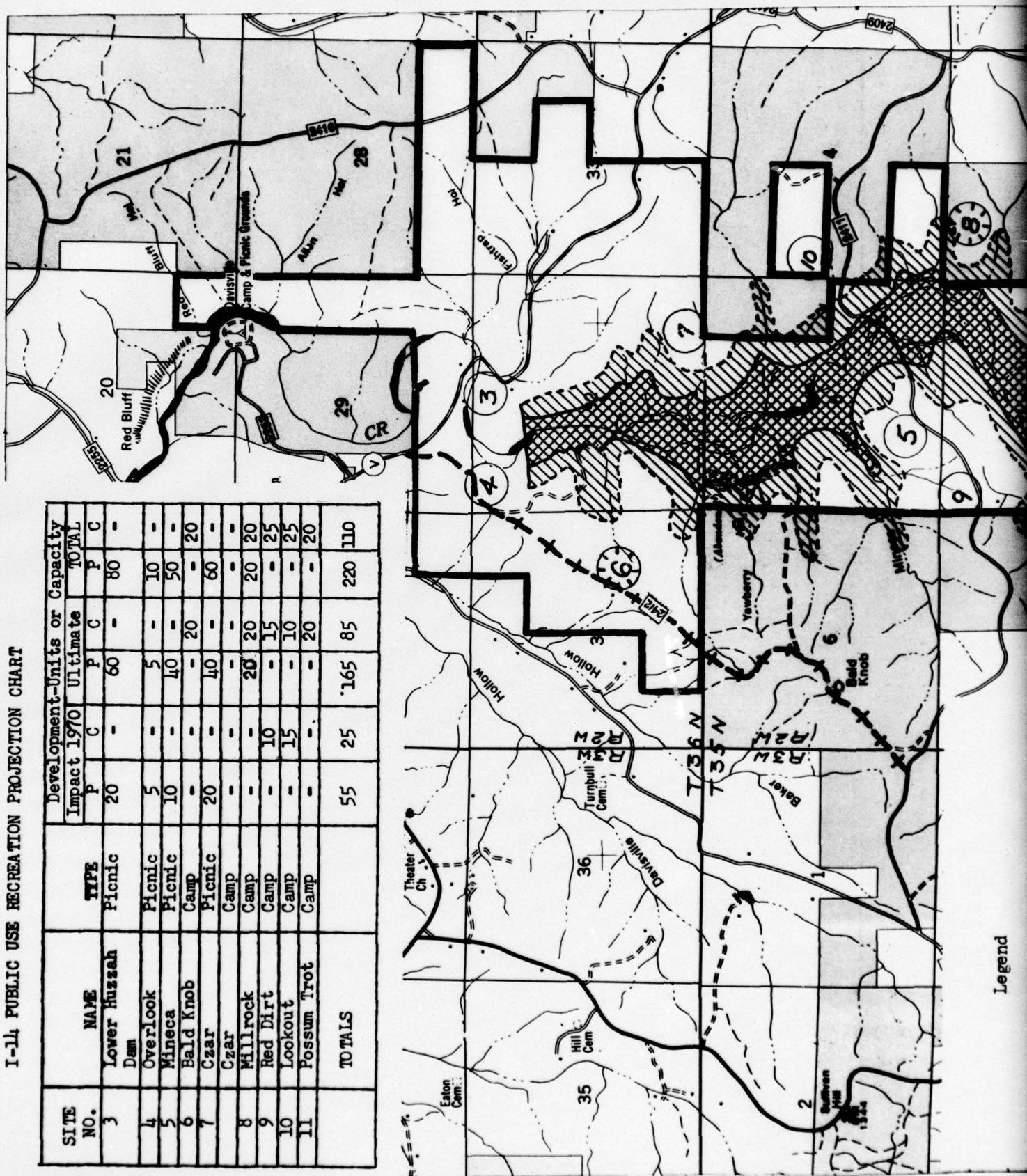
21'

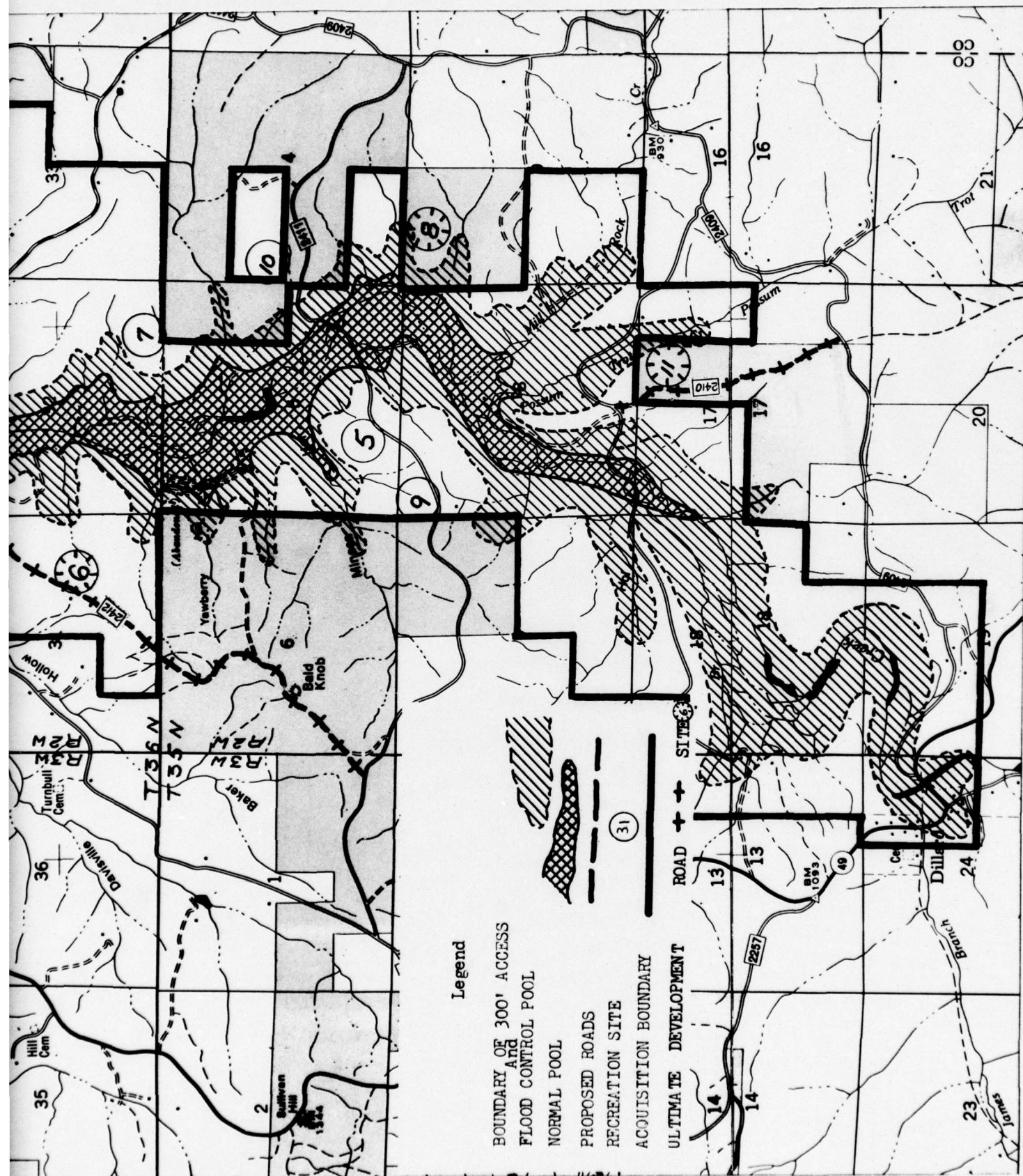
4

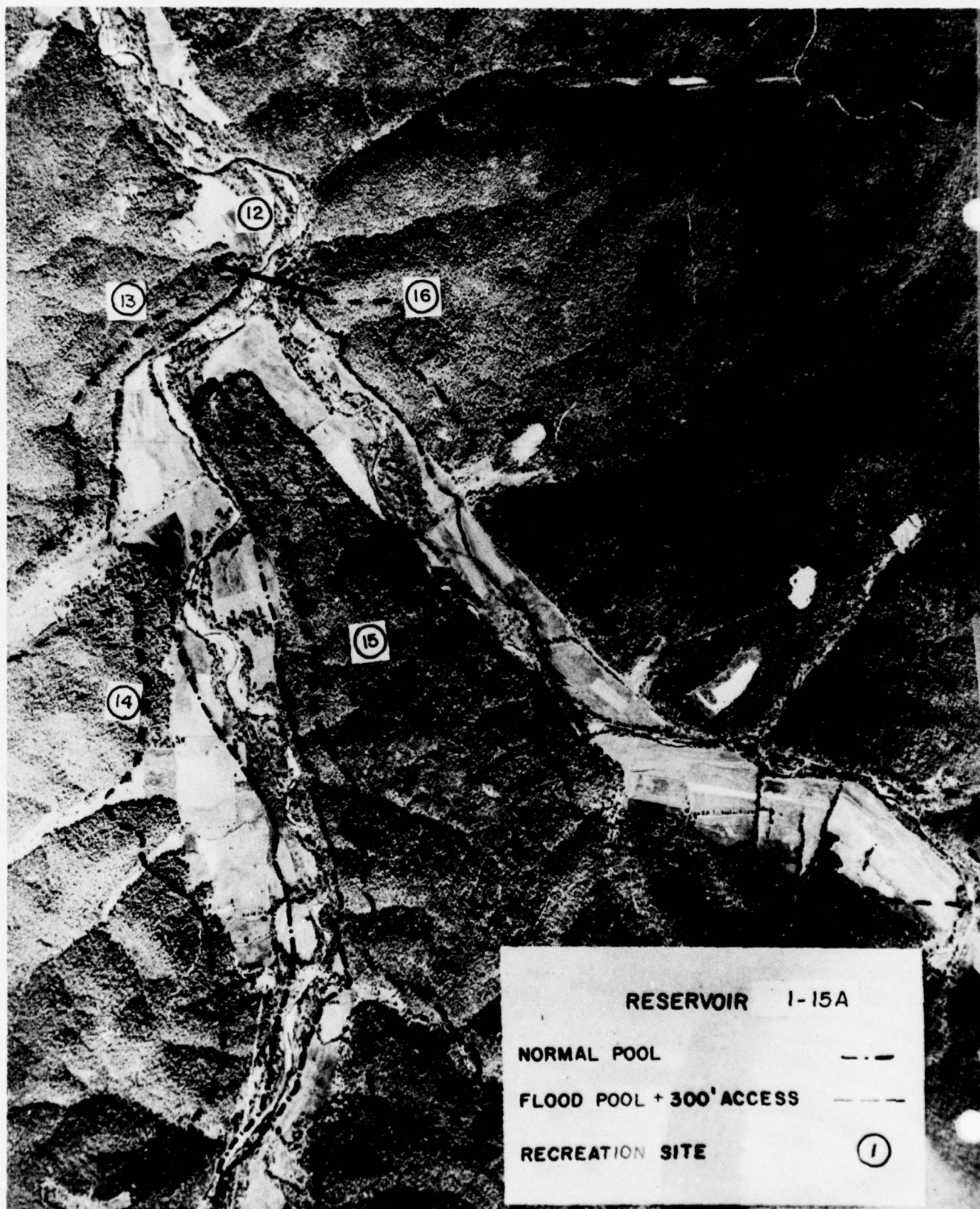


I-14 PUBLIC USE RECREATION PROJECTION CHART

SITE NO.	NAME	TYPE	Development-Units or Capacity					
			Impact 1970			Ultimate		
			P	C	-	P	C	TOTAL
3	Lower Hussah Dam	Picnic	20	-	-	60	-	80
4	Overlook	Picnic	5	-	-	5	-	10
5	Minica	Picnic	10	-	-	40	-	50
6	Bald Knob	Camp	-	-	-	20	-	20
7	Czar	Picnic	20	-	-	40	-	60
8	Czar	Camp	-	-	-	-	-	-
9	Millrock	Camp	-	-	-	20	20	20
10	Red Dirt	Camp	-	10	-	15	-	25
11	Lookout	Camp	-	15	-	10	-	25
11	Possum Trot	Camp	-	-	-	20	-	20
	TOTALS		55	25	-	165	85	220 110

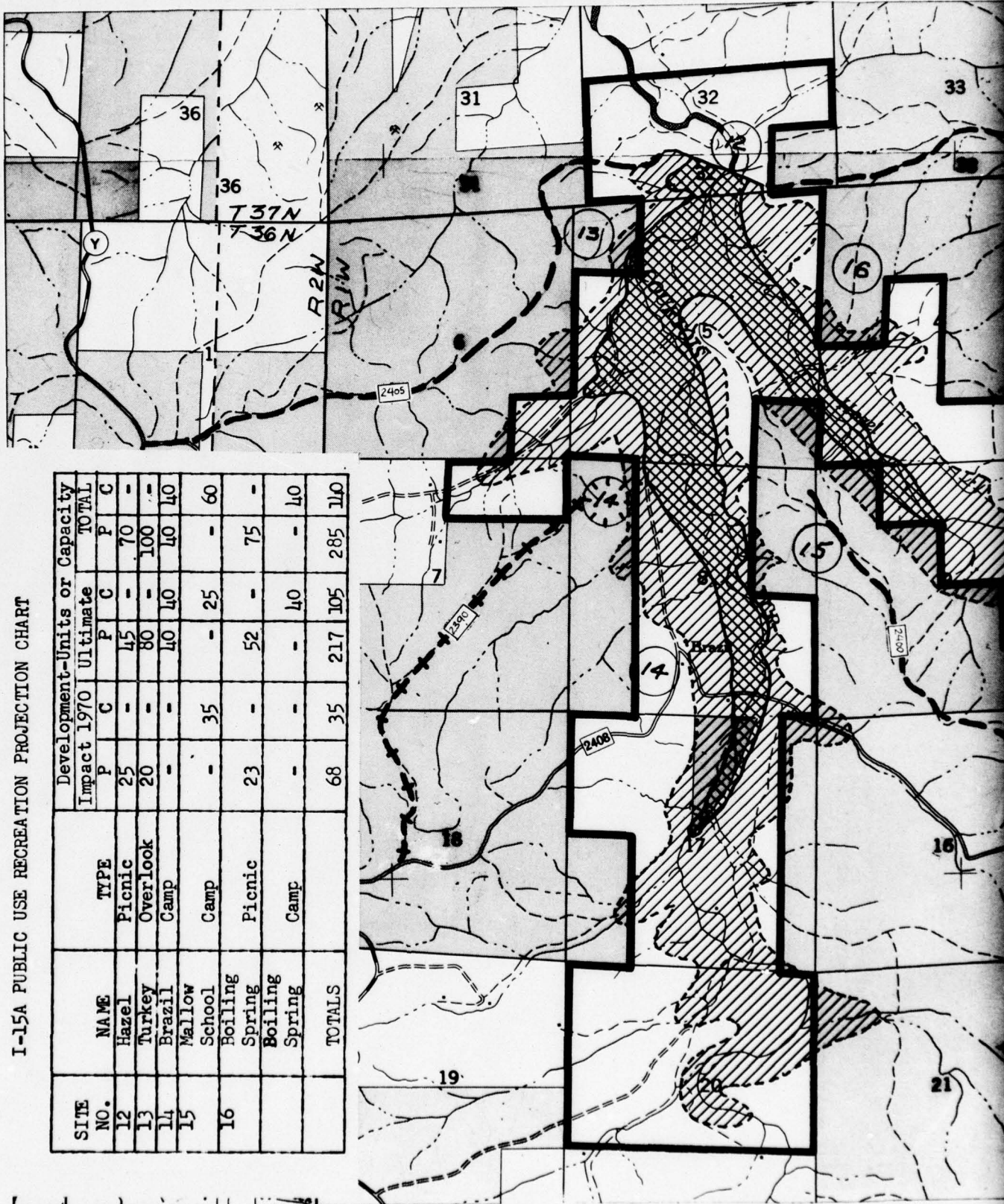


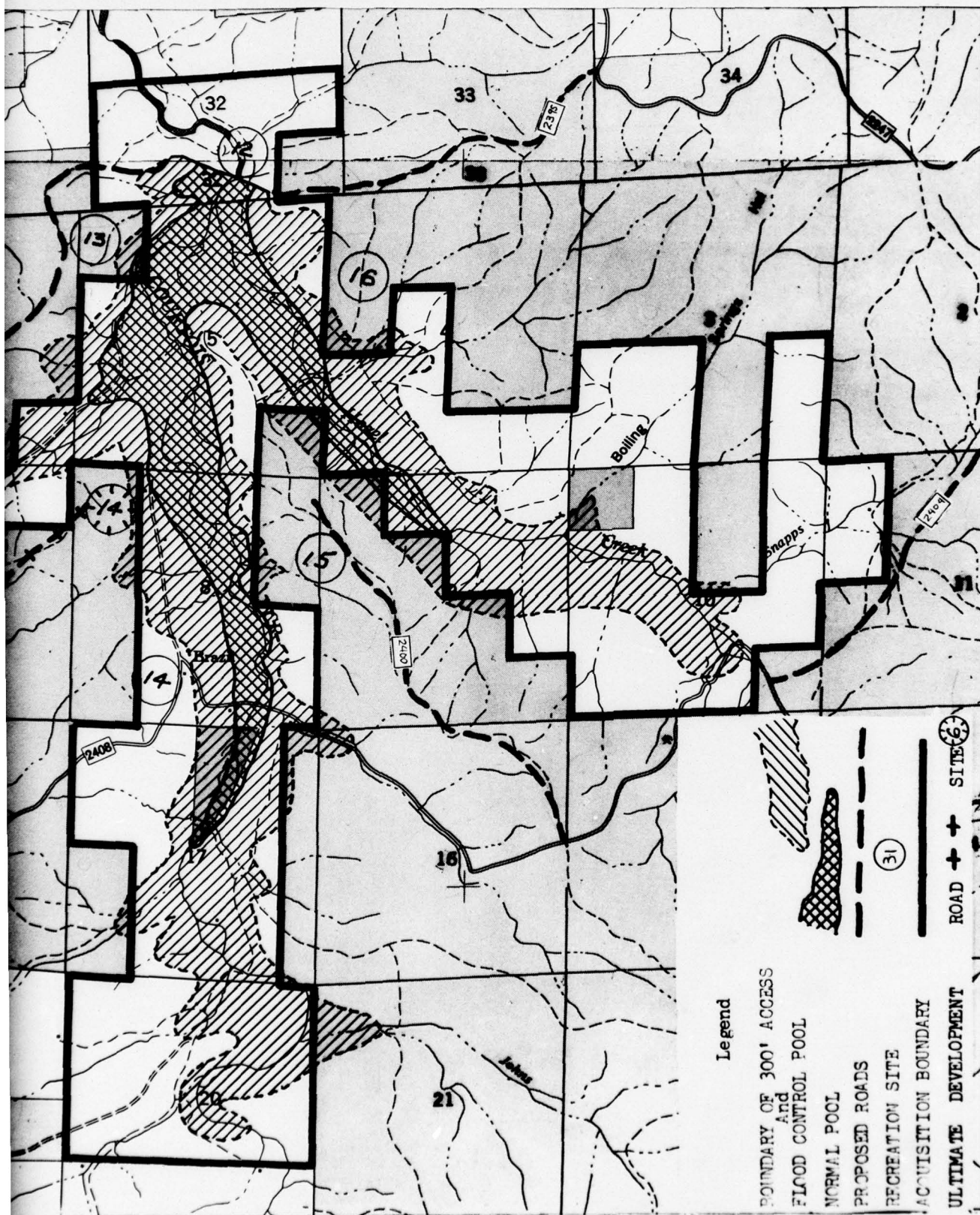




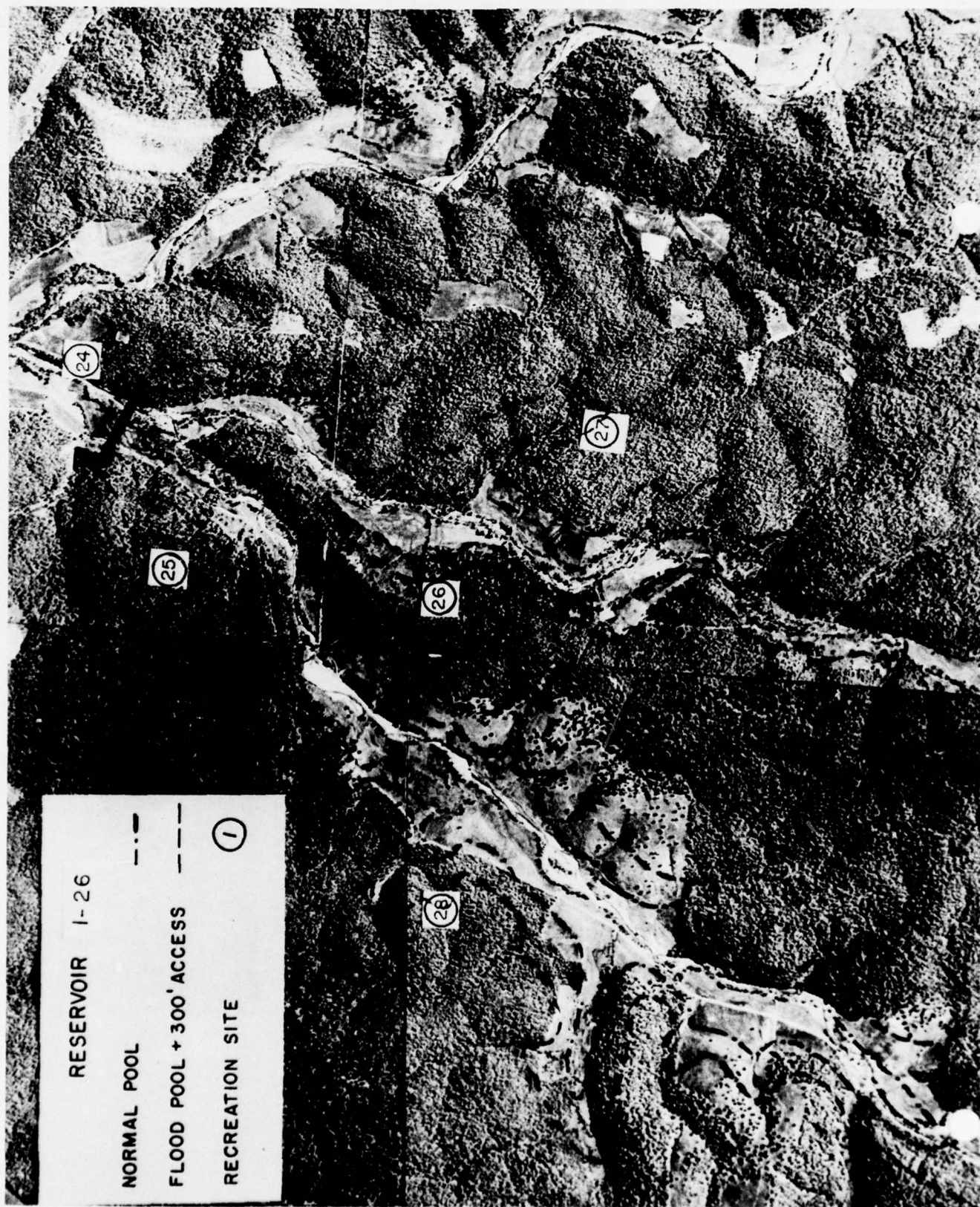
I-15A PUBLIC USE RECREATION PROJECTION CHART

SITE NO.	NAME	TYPE	Development-Units or Capacity				
			Impact 1970	Ultimate	TOTAL		
			P	C	P	C	
12	Hazel	Picnic	25	-	45	-	70
13	Turkey	Overlook	20	-	80	-	100
14	Brazil	Camp	-	-	40	40	40
15	Mallow	Camp	-	35	-	25	60
16	Boiling Spring	Picnic	23	-	52	-	75
	Boiling Spring	Camp	-	-	-	40	40
	TOTALS		68	35	217	105	285



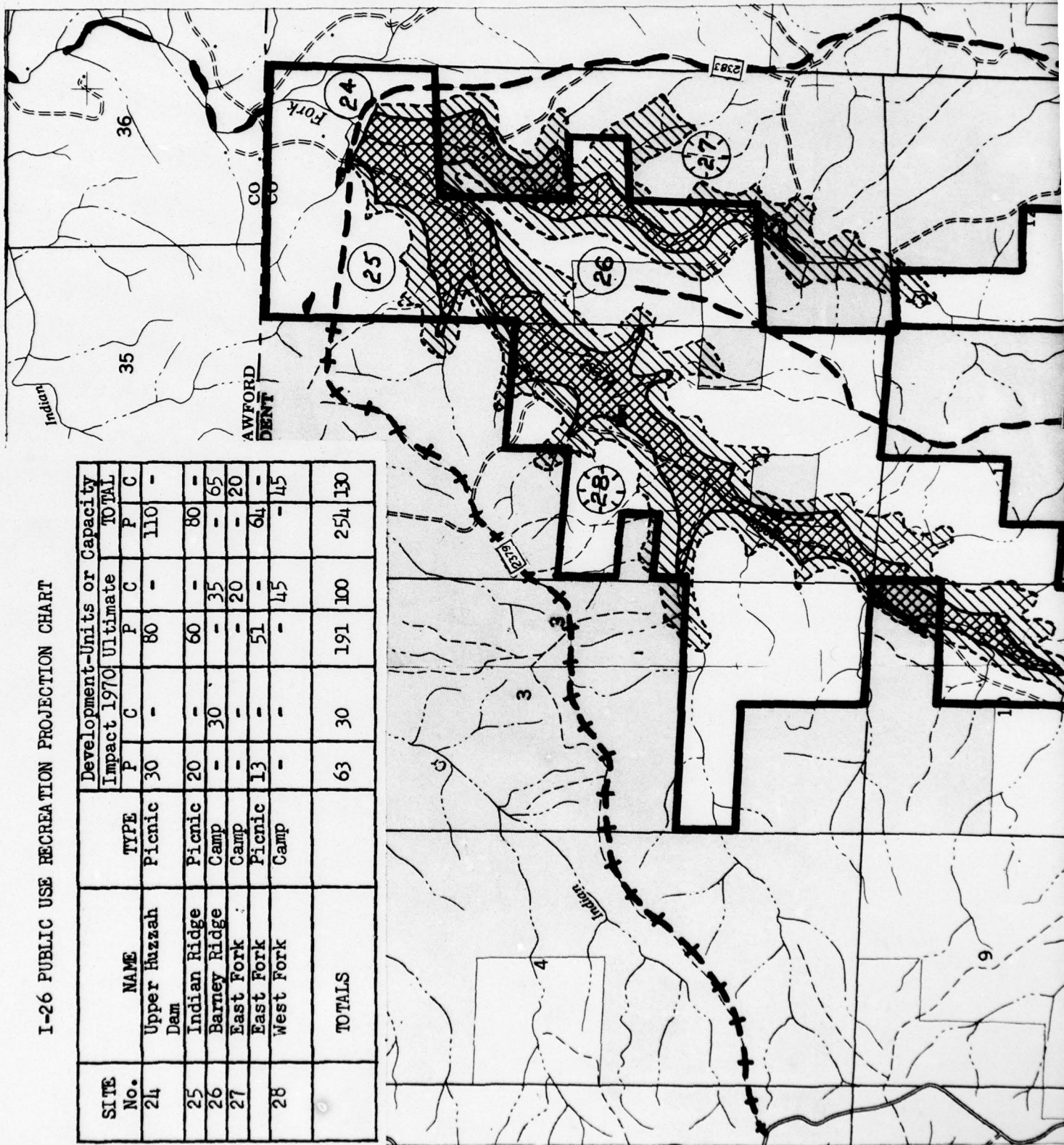


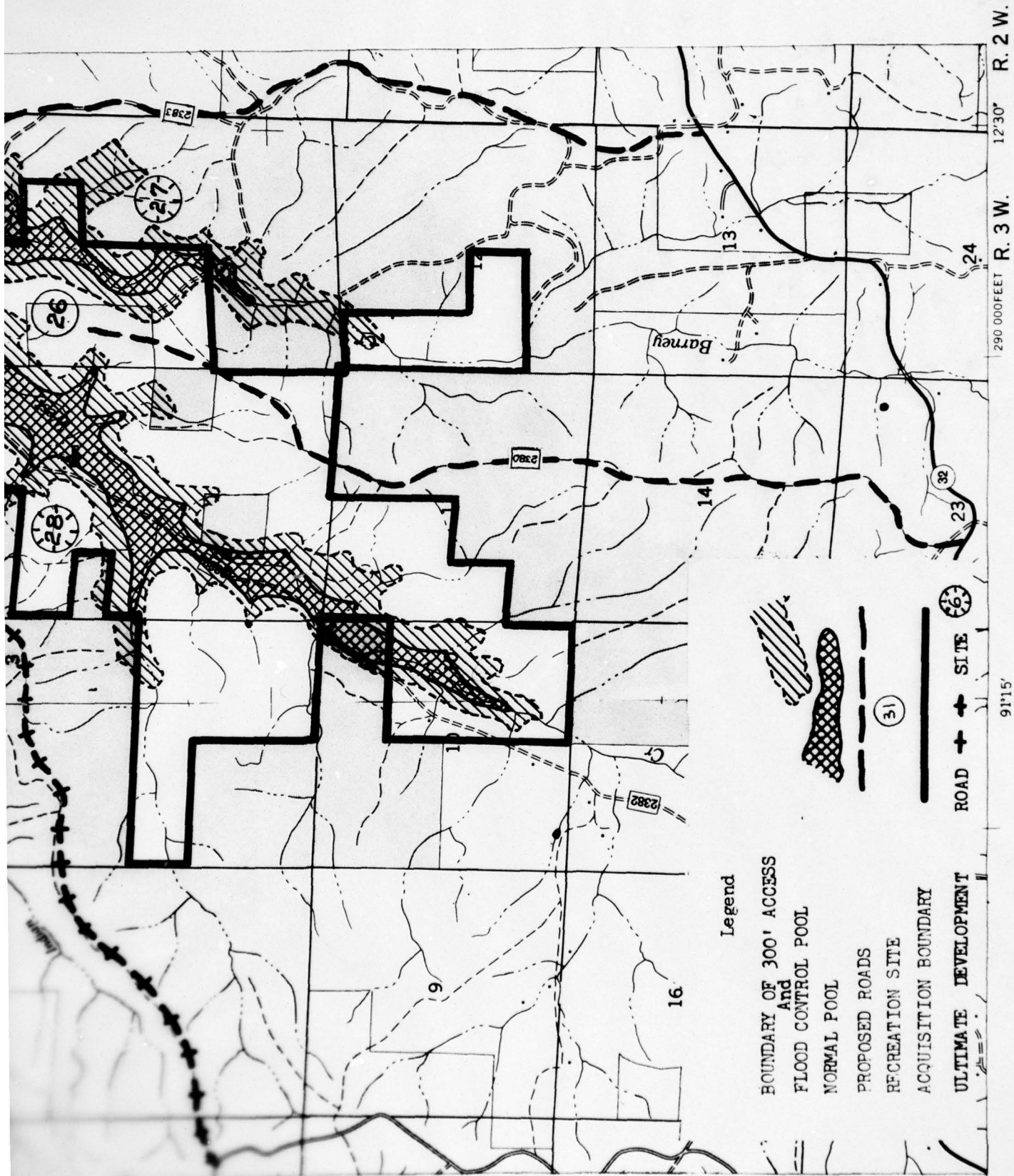
2



I-26 PUBLIC USE RECREATION PROJECTION CHART

SITE No.	NAME	TYPE	Development-Units or Capacity				
			Impact 1970		Ultimate		TOTAL
			P	C	P	C	
24	Upper Huzzah Dam	Picnic	30	-	80	-	110
25	Indian Ridge	Picnic	20	-	60	-	80
26	Barney Ridge	Camp	-	30	-	35	65
27	East Fork	Camp	-	-	-	20	20
	East Fork	Picnic	13	-	51	-	64
28	West Fork	Camp	-	-	-	45	45
	TOTALS		63	30	191	100	254
							130





Legend

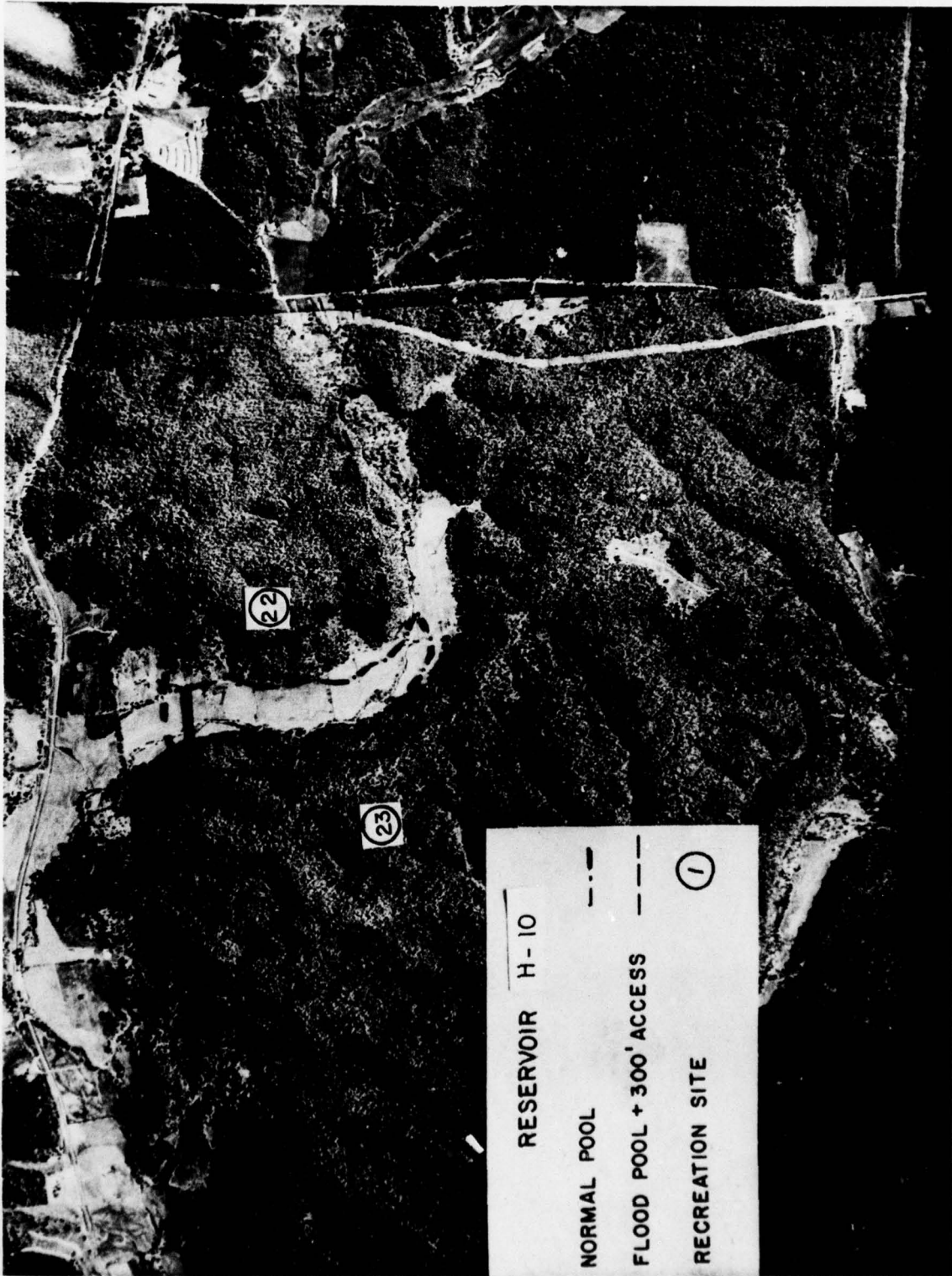
- BOUNDARY OF 300' ACCESS
- And
- FLOOD CONTROL POOL
- NORMAL POOL
- PROPOSED ROADS
- RECREATION SITE
- ACQUISITION BOUNDARY
- ULTIMATE DEVELOPMENT
- ROAD + + SITE

9115'

290 000 FEET

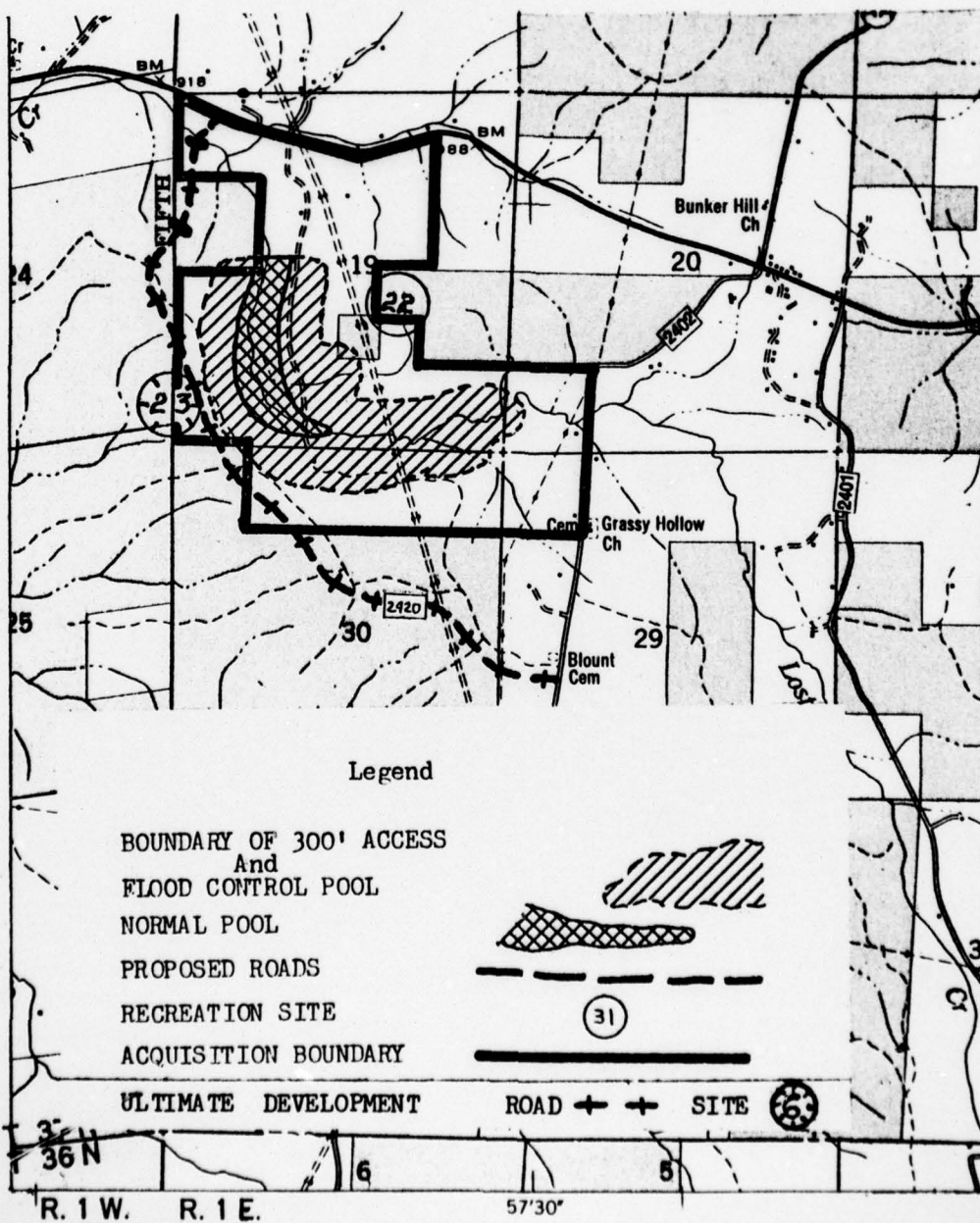
12'30" R. 2 W.

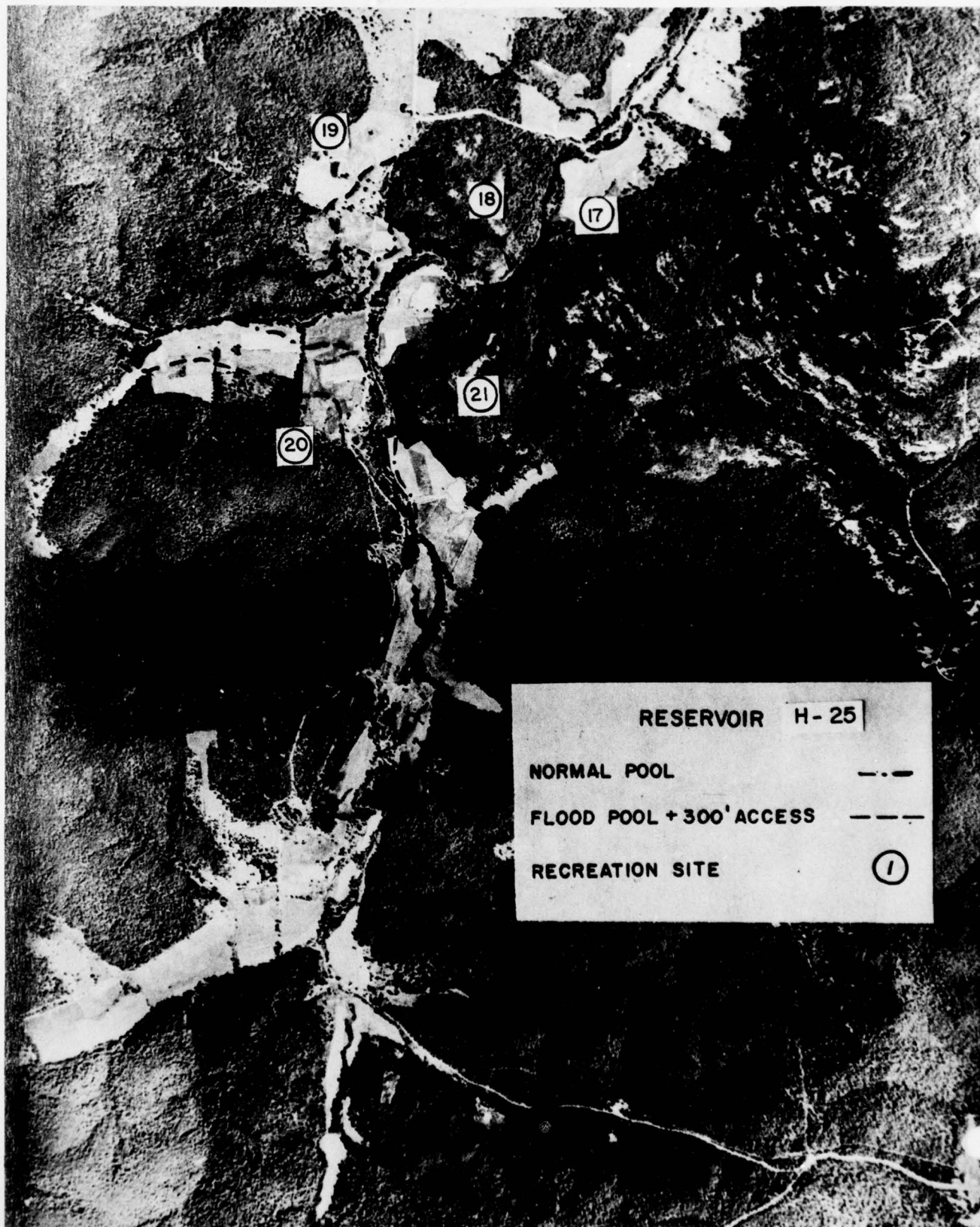
R. 3 W.



H-10 PUBLIC USE RECREATION PROJECTION CHART

SITE NO.	NAME	TYPE	Development-Units or Capacity					
			Impact 1970		Ultimate		TOTAL	
			P	C	P	C	P	C
22	Lost Creek	Picnic	10	-	7	-	17	-
23	Lost Ridge	Camp	-	-	-	10	-	10
	TOTALS		10	-	7	10	17	10

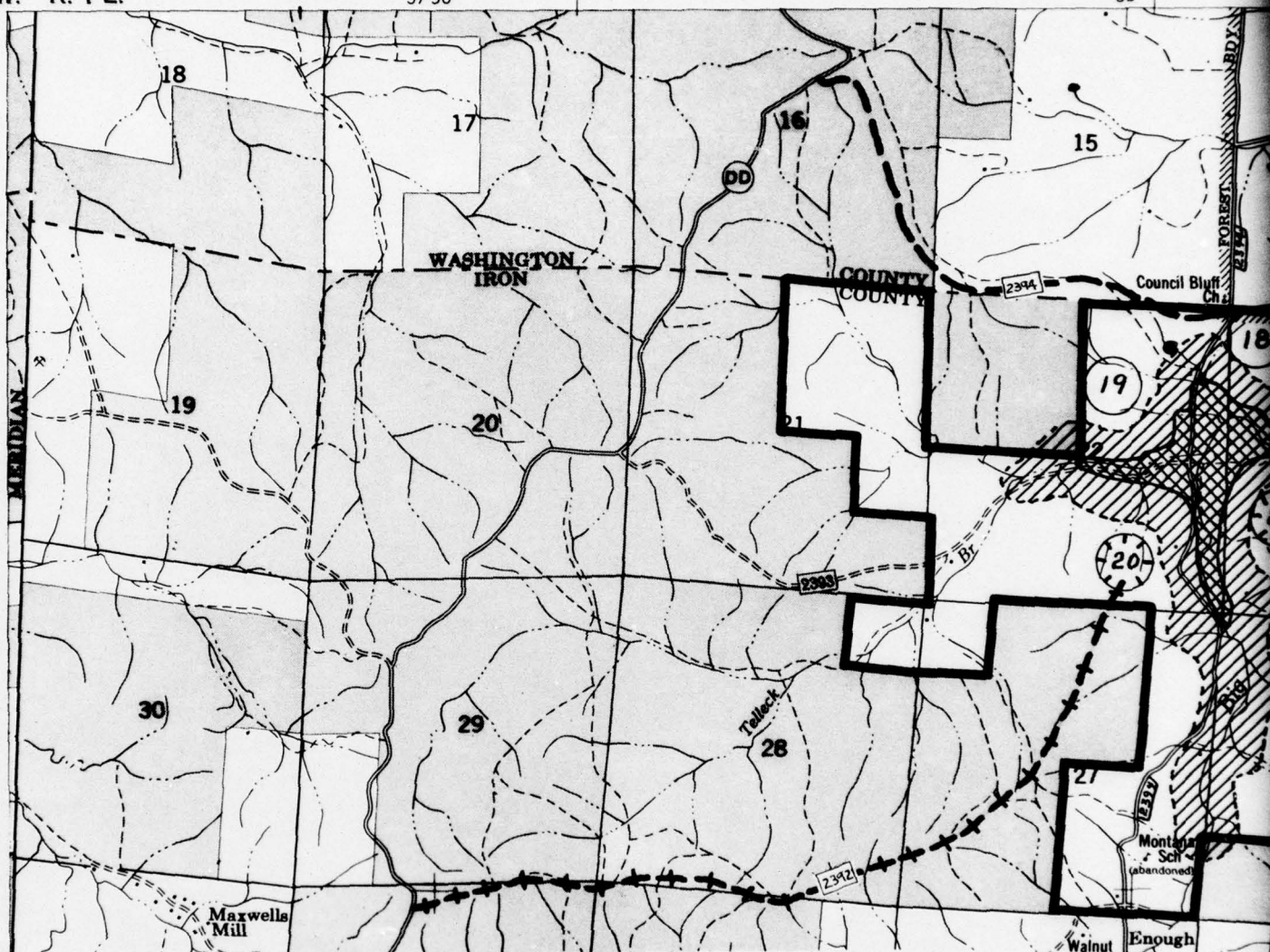




R. 1 W. R. 1 E.

57°30'

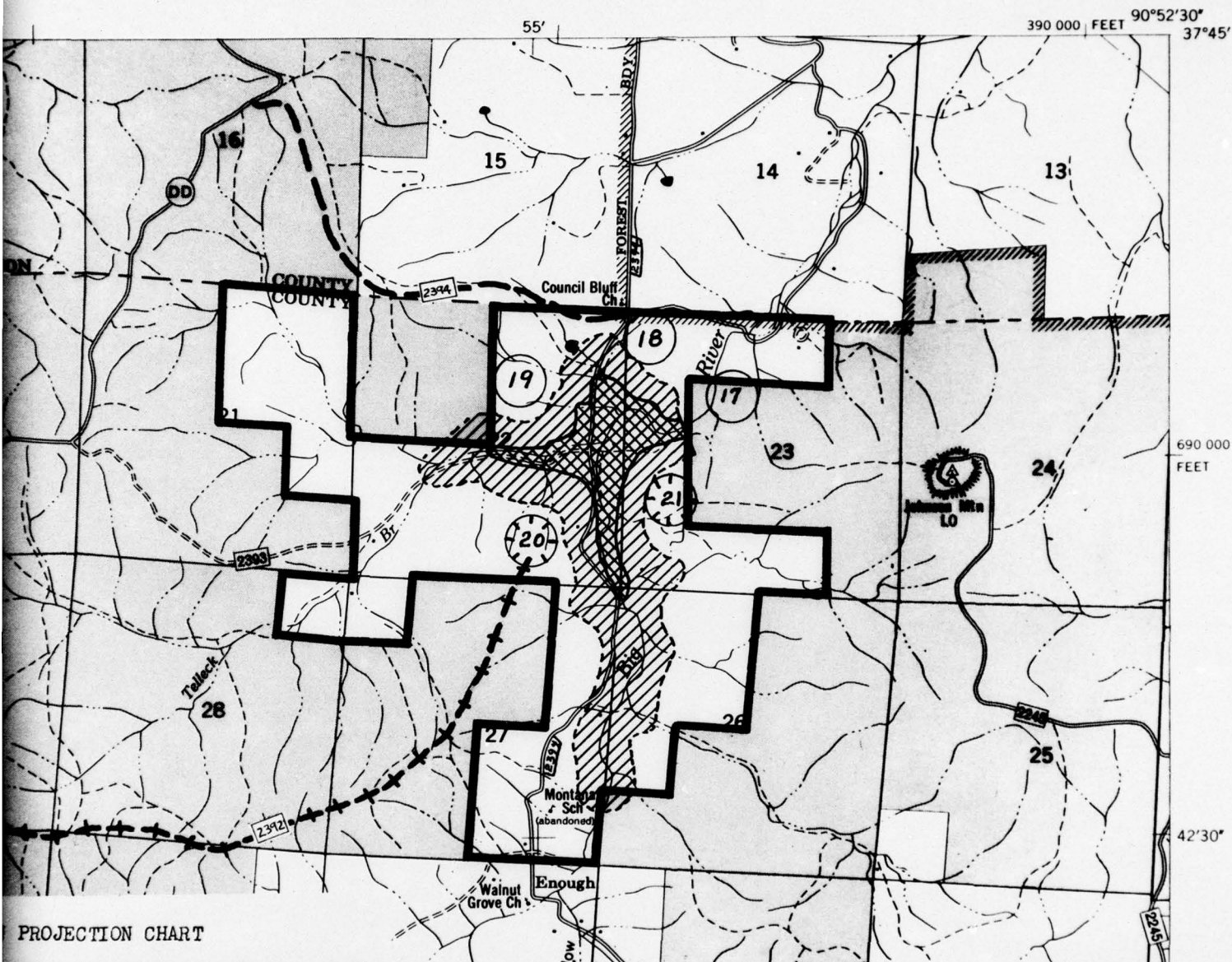
55'



H-25 PUBLIC USE RECREATION PROJECTION CHART

SITE NO.	NAME	TYPE	Development-Units or Capacity					
			Impact 1970		Ultimate		TOTAL	
			P	C	P	C	P	C
17	Big River Dam	Picnic	14	-	16	-	30	-
18	Council Bluff	Picnic	-	-	10	-	10	-
19	Telleck Br.	Camp	-	5	-	5	-	10
20	Enough	Camp	-	-	-	10	-	10
21	Johnson Mt.	Picnic	-	-	10	-	10	-
	TOTALS		14	5	36	15	50	20

BOUNDARY OF
And
FLOOD CONTROL
NORMAL POOL
PROPOSED ROAD
RECREATION SITE
ACQUISITION
ULTIMATE DEV



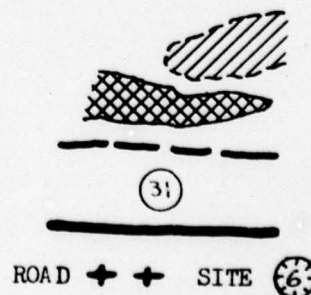
PROJECTION CHART

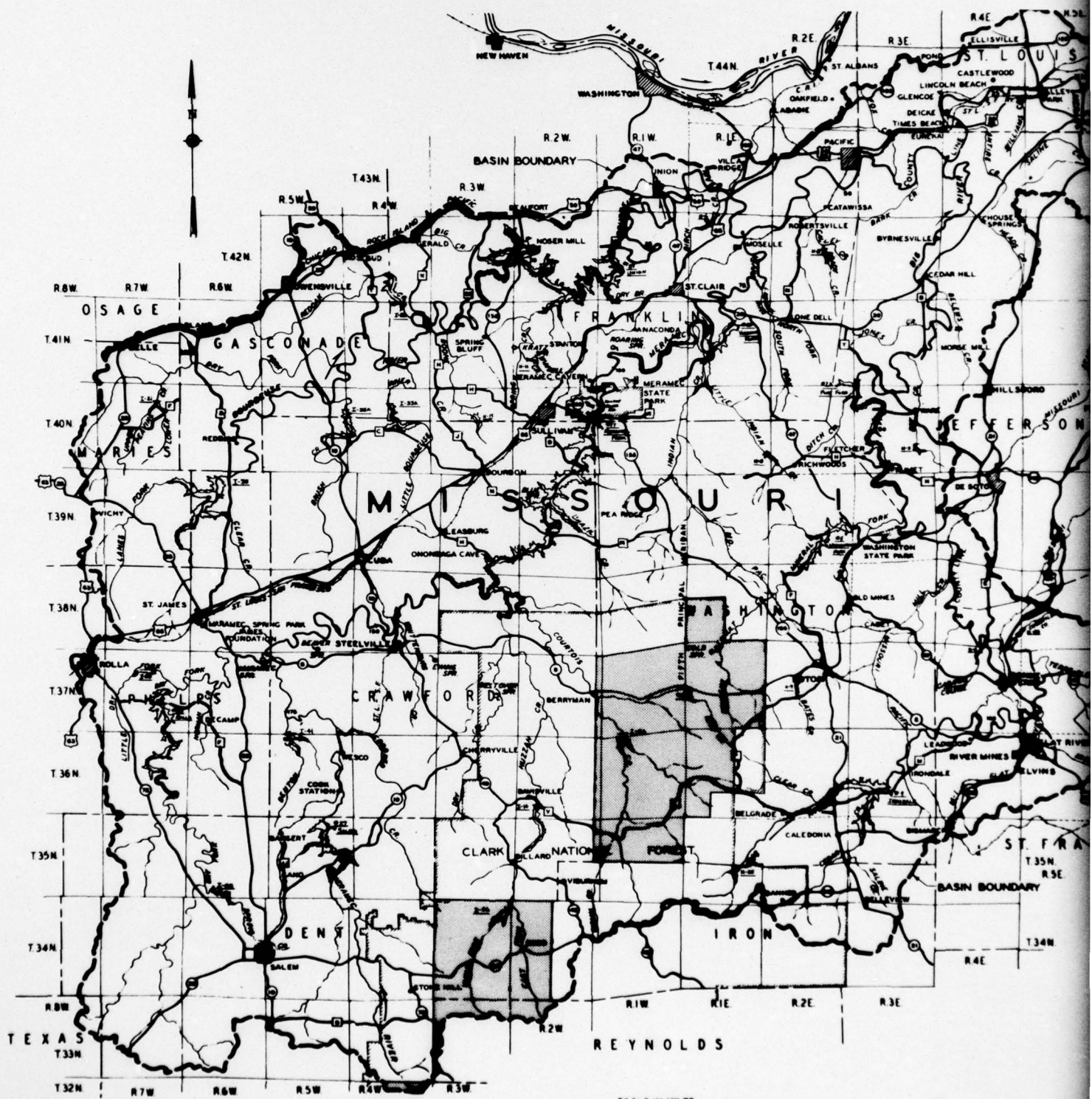
Development-Units or Capacity		Impact 1970		Ultimate		TOTAL	
P	C	P	C	P	C	P	C
14	-	16	-	30	-		
-	-	10	-	10	-		
-	5	-	5	-	10		
-	-	-	10	-	10		
-	-	10	-	10	-		
14	5	36	15	50	20		

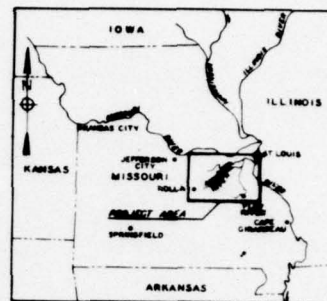
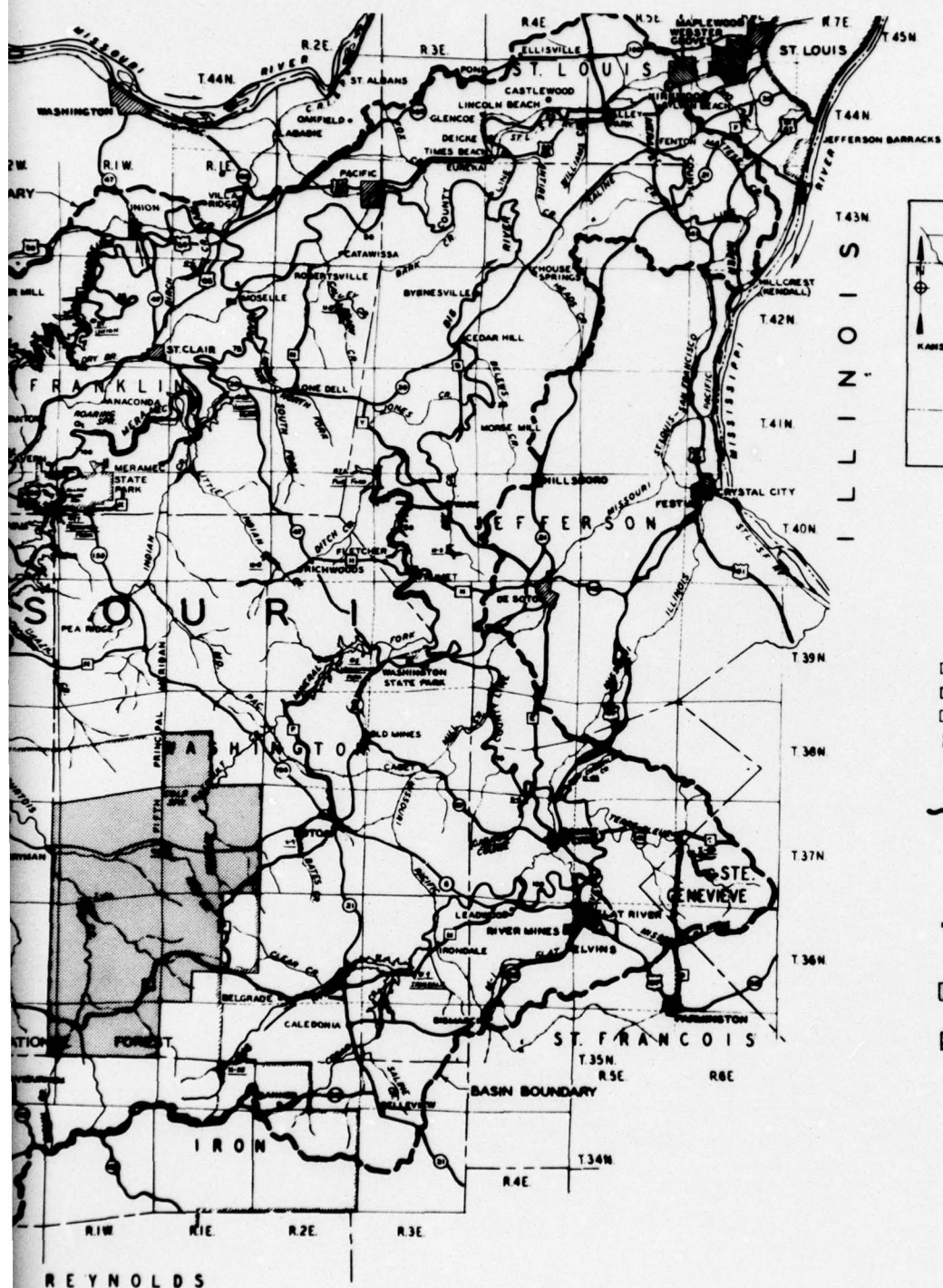
34

Legend

BOUNDARY OF 300' ACCESS
And
FLOOD CONTROL POOL
NORMAL POOL
PROPOSED ROADS
RECREATION SITE
ACQUISITION BOUNDARY
ULTIMATE DEVELOPMENT







LEGEND

LEVEES

- MAJOR RESERVOIR
- INTERMEDIATE RESERVOIR
- HEADWATER RESERVOIR
- U.S. ROUTE MARKER
- STATE ROUTE MARKER
- SUPPLEMENTARY ROUTE MARKER
- BASIN BOUNDARY

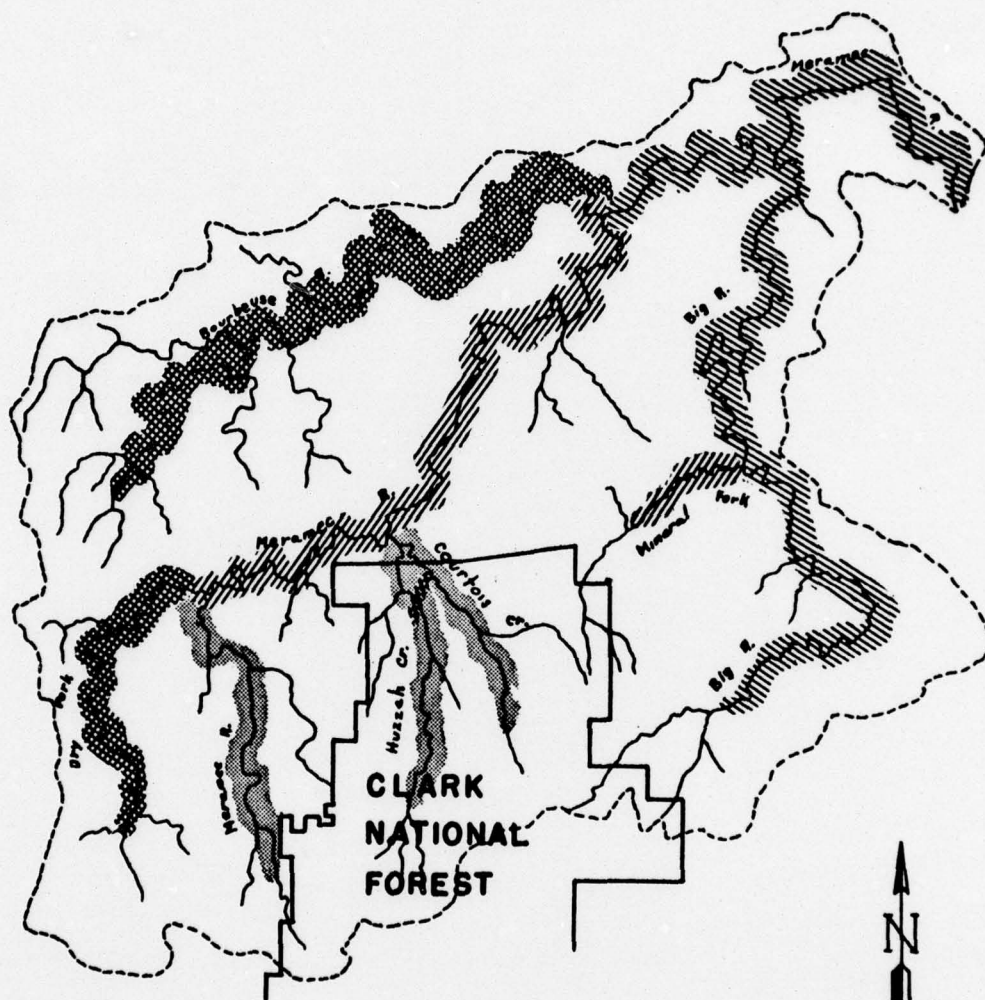
NOTE: NORMAL POOL ELEVATIONS SHOWN
LIMITS AND DETAILS ARE TENTATIVE

- Open Range
1962
- Forest Boundary

SCALE IN MILES

2

MERAMEC BASIN STREAM TURBIDITY



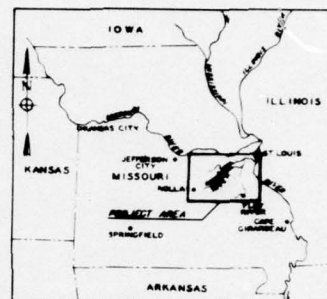
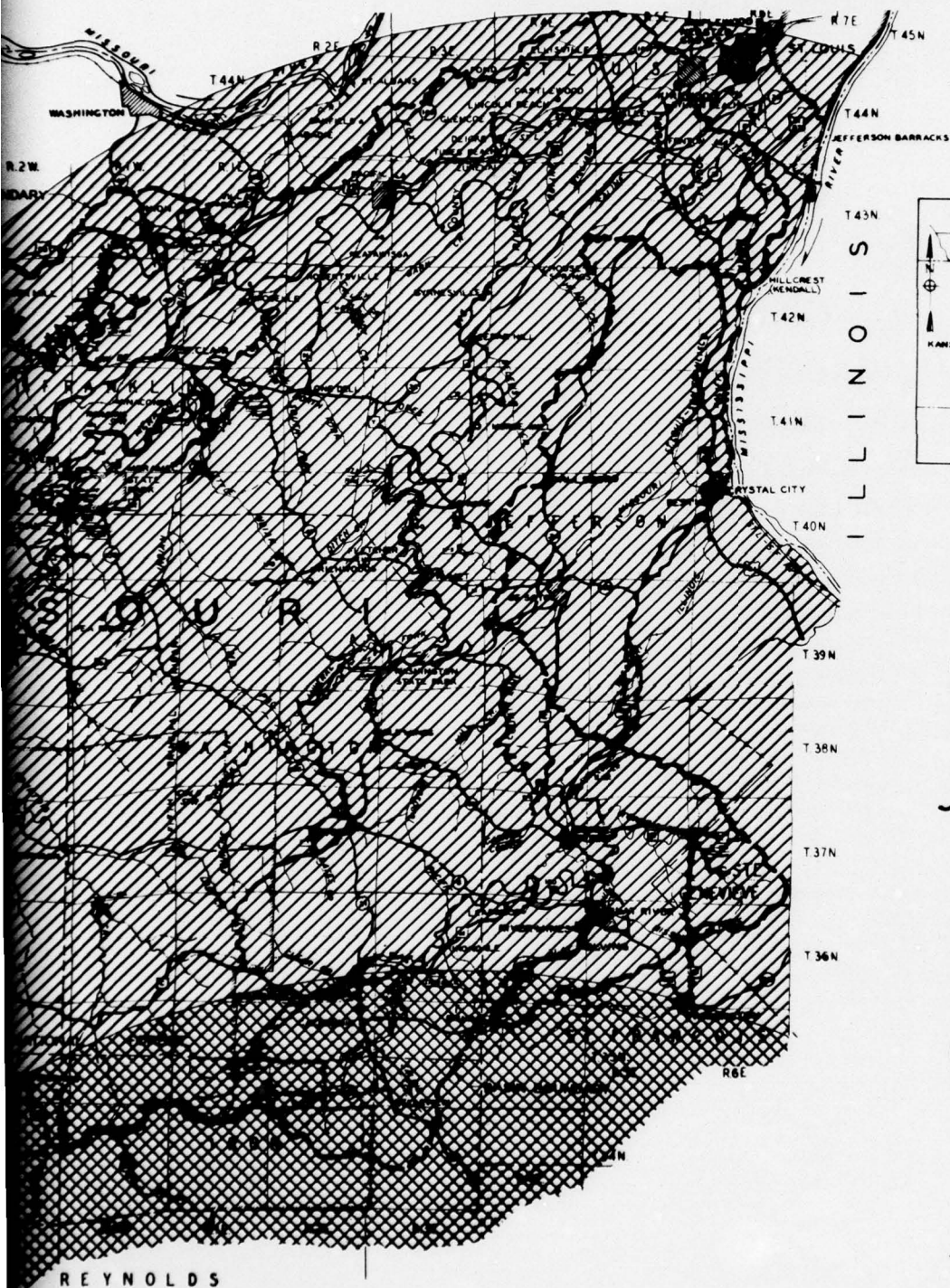
U.S.D.A. MERAMEC PRELIMINARY
STUDY - 1942

ESTIMATE OF ANNUAL SUPPLY OF HARDWOOD AND PINE CORDWOOD
IN AN AREA WITHIN A FIFTY-MILE RADIUS OF LEEPER, MO.
ALL FORESTED OWNERSHIPS

COUNTY AND % OF COUNTY WITHIN RADIUS ZONE	COMMERCIAL FOREST LAND (THOUSAND ACRES)	ESTIMATED HARDWOOD CUT (THOUSAND CORDS)	ESTIMATED AN- NUAL SOFTWOOD CUT (THOUSAND CORDS)
WASHINGTON 13%	47	5.0	0.4
ST. FRANCOIS 51%	75	7.0	0.2
BOLLINGER 81%	173	15.0	0.6
CAPE GIRARDEAU 6%	6	1.0	0.1
MADISON 100%	226	22.0	1.5
IRON 100%	277	32.0	2.3
DENT 24%	78	5.0	0.5
REYNOLDS 100%	419	46.0	3.3
SHANNON 83%	428	42.0	2.9
OREGON 60%	215	21.0	2.3
CARTER 100%	269	34.0	2.6
WAYNE 100%	376	37.0	3.3
STODDARD 70%	90	9.0	-
BUTLER 100%	244	27.0	1.4
RIPLEY 100%	<u>305</u>	<u>31.0</u>	<u>2.6</u>
	3228	334.0	24.0
PERRY 3%	}	NO ESTIMATES	(38% is NF)
STE. GENEVIEVE 3%			
		(21% is NF)	

ESTIMATE OF ANNUAL SUPPLY OF HARDWOOD AND PINE
CORDWOOD IN AN AREA WITHIN A FIFTY-MILE RADIUS OF
LEADWOOD, MISSOURI
ALL FORESTED OWNERSHIPS

COUNTY AND % OF COUNTY WITHIN RADIUS ZONE	COMMERCIAL FOREST LAND (THOUSAND ACRES)	ESTIMATED HARDWOOD CUT (THOUSAND CORDS)	ESTIMATED AN- NUAL SOFTWOOD CUT (THOUSAND CORDS)
BOLLINGER 55%	160	14.0	0.6
CAPE GIRARDEAU 9%	8	1.0	-
CRAWFORD 82%	292	27.0	1.1
DENT 36%	123	8.0	0.8
FRANKLIN 65%	170	16.0	-
JEFFERSON 100%	230	22.0	-
IRON 100%	290	32.0	2.3
MADISON 100%	229	22.0	1.5
PERRY 74%	82	8.0	0.5
REYNOLDS 78%	349	36.0	2.6
STE. FRANCOIS 100%	159	14.0	0.4
STE. GENEVIEVE 100%	183	18.0	1.2
SHANNON 4%	19	2.0	0.8
WASHINGTON 100%	365	36.0	3.1
WAYNE 36%	135	13.0	1.2
ST. LOUIS 14%	<u>8</u>	<u>1.0</u>	<u>-</u>
	2802	270.0	16.1
		(27% NF)	(32% NF)



VICINITY MAP
SCALE IN MILES

LEGEND

LEVEES

- MAJOR RESERVOIR
- INTERMEDIATE RESERVOIR
- HEADWATER RESERVOIR
- U.S. ROUTE MARKER
- STATE ROUTE MARKER
- SUPPLEMENTARY ROUTE MARKER
- BASIN BOUNDARY

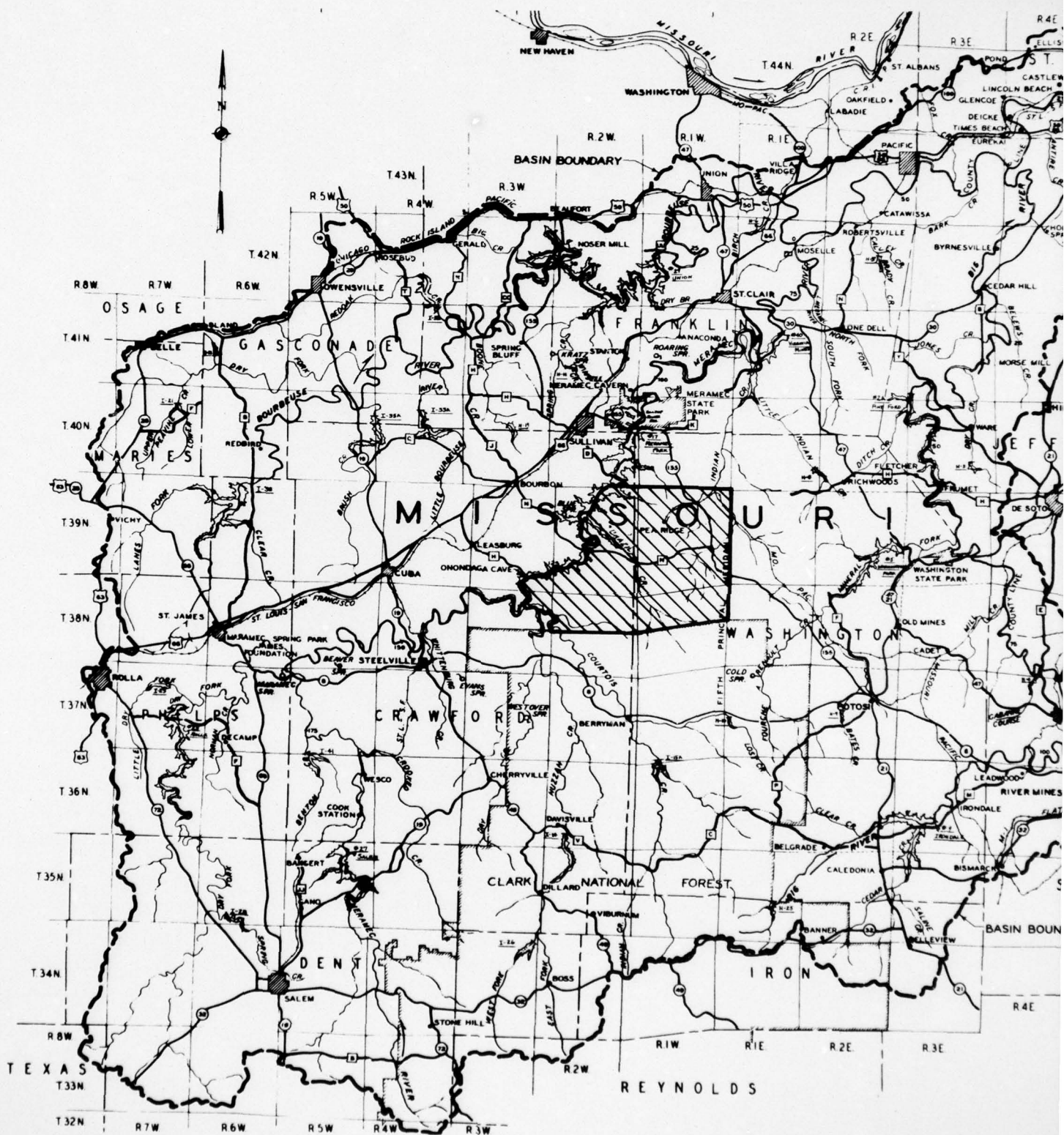
NOTE: NORMAL POOL ELEVATIONS SHOWN
LIMITS AND DETAILS ARE TENTATIVE

Hauling Zones to Potential
Wood Pulp Mill Sites

- Leadwood Hauling Zone
- Leeper Hauling Zone

SCALE IN MILES

2



AD-A041 698

ARMY ENGINEER DISTRICT ST LOUIS MO
MERAMEC RIVER, MISSOURI COMPREHENSIVE BASIN STUDY. VOLUME VII. --ETC(U)
JAN 64

F/G 13/2

UNCLASSIFIED

NL

2 of 3
ADA041698



ADA 041698



ESTIMATED COSTS OF PROVIDING FACILITIES AND SERVICES TO MEET THE ADDITIONAL
USE ATTRACTED BY THE PROJECTS
DATA BELOW IS THE SAME AS TABLE II OF CLARK NATIONAL FOREST
IMPACT REPORT SEPARATED BY INDIVIDUAL RESERVOIRS

PROJECT	1A. ROADS ACCESS AND SITE	1B. CAMPG'DS PICNIC SITE ETC.	1C. BOAT LANDING, PARKING, ETC.	1D. SWIMMING BEACHES AND POOLS	1E. RECREAT'N ADMNSTR'N HEAD- QUARTERS	1F. TRAILS	1G. LANDSCAP- ING SEEDING	2A ADVANCE PLANNING LIAISON ETC.	TOTAL PROJECT COST
17	44000	56463	15840	-	5500	-	2000	1000	124803
1-14	128700	148280	18150	22000	13200	4000	5000	2500	341830
1-15A	243100	166155	19525	22000	17050	4000	5000	2500	479330
1-26	87725	142923	18865	22000	15950	4000	4000	2500	297963
H-25	40975	40909	14795	22000	1100	4500	3000	2500	129779
H-10	-	21010	2750	-	2200	-	800	880	27640
TOTAL	544500	575740	89925	88000	55000	16500	19800	11880	1401345

**ESTIMATED COST OF FACILITIES AND SERVICES TO PROVIDE FOR THE ULTIMATE RECREATION
CAPACITY OF THE RESERVOIRS IN THE CLARK NATIONAL FOREST
PLANNED DEVELOPMENT BY DECADES 1970-2000 AND ANNUAL VISITS AND NET BENEFITS**

PROJECT	PERIOD	UNITS	TOTAL COSTS	ANNUAL			NET ANNUAL GAIN
				INCREASED VISITS	RECREATION VALUE	INCREASED MGT. COSTS FOLLOWING INSTALLATION	
#17	1970	33	\$124803	23500	\$ 37600	\$ 6047	\$ 31553
	1980	52	52000	37000	59200	7770	51430
	1990	32	32000	23000	36800	4830	31970
	2000	20	20000	14000	22400	2940	19460
TOTAL		137	\$228803	97500	\$156000	\$21587	\$134413
I-14	1970	80	341830	54000	86400	13894	72506
	1980	125	120320	84000	134400	18280	116120
	1990	75	75000	51000	81600	10710	70890
	2000	50	50000	34000	54400	7140	47260
TOTAL		330	\$587150	223000	\$356800	\$50024	\$306776
I-15A	1970	105	479330	70000	112000	18011	93989
	1980	160	195200	107000	171200	22870	148330
	1990	96	96000	64000	102400	13440	88960
	2000	64	64000	43000	68800	9030	59770
TOTAL		425	\$834530	284000	\$454400	\$63351	\$391049
I-26	1970	93	297963	61000	97600	15696	81904
	1980	145	60650	94000	330400	20340	310060
	1990	88	88000	58000	92800	12180	80620
	2000	58	58000	38000	60800	7980	52820
TOTAL		384	\$504613	251000	\$581600	\$56196	\$525404
H-25	1970	19	129779	10000	16000	2752	13248
	1980	26	60650	14000	22400	3540	18860
	1990	15	15000	8000	12800	1680	11120
	2000	10	10000	5200	8320	920	7400
TOTAL		70	\$215429	37200	\$59520	\$8892	\$50628
H-10	1970	10	27640	4000	6400	1030	5370
	1980	17	61000	6800	10880	1928	8952
TOTAL		27	\$88640	10800	\$17280	\$2958	\$14322
GRAND TOTAL			\$2459165				\$1422592

COMPREHENSIVE REPORT

**MERAMEC RIVER BASIN,
MISSOURI**

APPENDIX O

EFFECT ON FISH AND WILDLIFE



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
1006 WEST LAKE STREET
MINNEAPOLIS, MINNESOTA 55408

In reply refer to:

RB

January 28, 1964

District Engineer
U. S. Army Engineer District
St. Louis
420 Locust Street
St. Louis 2, Missouri

Dear Sir:

This is our Preliminary Report on the water development plan for the Meramec River Basin, Missouri. The project investigation was authorized by House Resolution dated April 16, 1960 (86th Congress). This report was prepared in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq). The report treats anticipated effects of the project on associated fish and wildlife resources. It also contains general recommendations concerned with the preservation or development of these resources.

The analysis of project effects on fish and wildlife is necessarily limited in scope, as the basin plan is preliminary and detailed engineering data is not yet available. A map and three tables are included in this letter. The tables provide a summary of preliminary engineering data, together with estimates of fishing and hunting use, with and without the project. The tables are based on the assumption that all units will ultimately be built. Resources affected by the project have been evaluated in accordance with the formula adopted by the Inter-Agency Committee on Water Resources. Project data furnished by your office during 1962 and 1963 provide the basis for our analysis. Additional fish and wildlife investigations will be conducted when further studies are authorized and after more detailed water development plans become available.

Our studies have been coordinated with members of your staff, plus personnel of the Missouri Conservation Commission, U. S. Forest Service, U. S. Geological Survey, Bureau of Outdoor Recreation, U. S. National Park Service, Meramec Basin Corporation, and other governmental and private organizations. We acknowledge, with thanks, the assistance rendered us throughout the course of our study by all groups and individuals.

This report has the concurrence of the Missouri Conservation Commission.

DESCRIPTION OF THE AREA

The Meramec River Basin is 3,980 square miles in area and lies southwest of St. Louis in the Ozarks of eastern Missouri. It is drained by the Meramec River, which extends some 240 miles from its source to its terminus with the Mississippi River near St. Louis. The Big and Bourbeuse Rivers are its two major tributaries.

The portion of the Ozarks occupied by the Meramec Basin is underlain with massive granite, covered with bedded sedimentary formations. The rugged terrain of the southern part of the basin gradually merges into gently rolling country to the north. Numerous even-flowing springs are present, particularly in the Big River and Meramec River drainages.

The economy of the basin is based largely on agriculture, mining, forest products, and recreation. The relatively fertile flood plains provide most of the croplands. The thin-soiled uplands are extensively timbered and farming operations are marginal. Land use in the basin is as follows: 22 per cent cropland, 15 per cent pasture, 60 per cent woodlands, and 3 per cent miscellaneous.

Public lands in the basin include approximately 200,000 acres of national forest lands and over 34,000 acres of parks, forests, and wildlife refuges in State ownership. Commercial public-recreation facilities are concentrated along main streams and at several caves and springs.

DESCRIPTION OF THE PROJECT

The proposed project includes the construction of 7 major dams on the Meramec, Big, Bourbeuse, and Mineral Fork Rivers and 24 minor dams on smaller tributaries. (Table 1). A series of levees is being considered to protect the lower Meramec River flood plains.

Water development on major streams will be for purposes of flood control, water supply, pollution abatement, flow regulation, hydroelectric power production, recreation, and fish and wildlife. The smaller, upland impoundments will serve recreation and fish and wildlife needs primarily.

FISH AND WILDLIFE RESOURCES

Without the Project

The Meramec Basin contains a variety of fish and wildlife which provide substantial recreational opportunities. It includes over 1,300 miles of fishable streams and thousands of acres of good wildlife habitat.

Sport fishing ranges from fair to excellent. Those streams which are clear and accessible provide some of the better fishing in the Missouri Ozarks.

Table 1. Engineering Data, Meramec Basin Reservoirs ^{1/}

Reservoir Site	Elevations (m.s.l.)		Flood Pool		Normal Pool		
	Spillway Crest	Streambed at dam	Storage (ac. ft.)	Area (acres)	Storage (ac. ft.)	Area (acres)	Shoreline (miles)
<u>Big River</u>							
<u>Subbasin</u>							
# 9	860	760	106,160	5,100	54,840	2,500	40
# 5	706	590	98,110	3,500	49,055	1,700	28
# 2A	595	496	196,000	8,100	88,300	3,700	57
I-30	790	745	5,480	400	1,620	190	7
H-25	1,061	979	3,900	220	1,300	80	2
H-40	671	635	---	---	900	45	2
H-4	680	620	2,500	175	800	70	2
H-9	950	930	2,300	164	800	75	2
H-3	630	590	2,700	225	900	105	3
					198,515	8,465	143
<u>Meramec River</u>							
<u>Subbasin</u>							
#27	1,008	894	104,965	3,900	56,185	2,200	31
#17	701	566	581,560	22,300	418,440	12,600	190
#40	577	500	139,730	8,000	110,270	5,200	50
I-41	874	825	7,745	500	2,580	230	6
I-28	1,112	1,045	11,760	1,530	14,240	900	9
I-23	941	885	9,520	650	3,170	260	6
I-26	1,026	925	7,305	720	18,695	590	5
I-14	881	805	27,535	1,200	7,865	460	10
I-15A	834	765	29,590	1,500	8,410	620	12
H-10	982	935	1,300	90	500	40	1
H-8	723	660	5,000	300	1,700	140	4
H-5	543	505	1,000	90	300	30	2
					642,355	23,270	326
<u>Bourbeuse River</u>							
<u>Subbasin</u>							
#29	651	531	355,630	13,800	172,370	6,600	93
I-38	857	805	29,585	2,500	9,415	860	15
I-21	904	865	6,470	680	2,150	210	4
I-33A	777	705	13,845	1,200	12,155	750	9
I-35A	786	725	18,040	1,300	7,960	725	11
I-32	718	665	15,785	1,300	10,215	700	7
H-31	882	850	1,700	160	600	85	1
H-13	824	785	5,000	440	1,700	210	5
H-11	798	745	3,600	270	1,200	110	3
H-6	530	495	2,900	220	1,000	105	2
					218,765	10,355	150
					1,059,635	42,090	619

^{1/} Based upon data provided by St. Louis District, Corps of Engineers, through September 1963.

Lake fishing is of minor importance. Game fish such as smallmouth bass, largemouth bass, walleyes, catfishes, and other desirable warm-water species predominate in the creel. A minor "put and take" trout fishery exists in the Meramec drainage. Fisherman-use along project-affected reaches of permanent streams in the basin exceeds 230,000 angler days annually.

Important game animals include white-tailed deer, wild turkeys, cottontail rabbits, bobwhite quail, mourning doves, and squirrels. Foxes, raccoons, and opossums are also important. Waterfowl hunting is limited. Mink, muskrats, and beaver are the more important fur animals. The annual fur animal harvest is relatively unimportant but provides supplemental income to numerous part-time trappers. Areas of the basin that will be directly affected by the project support over 6,500 hunter-days use annually.

With the Project

A growing population of over 2,500,000 primarily in metropolitan St. Louis, resides within a 2-hour driving radius of the basin center. A substantially increased utilization of the fish and wildlife resource is anticipated with the project. The close proximity to St. Louis of these 31 developments and their associated fish and game resources will help promote this heavy use.

The project will have a decided impact on fishery resources. An estimated 135 miles of high-quality, irreplaceable stream fishing waters will be lost through permanent inundation. In its place substantial reservoir fisheries will develop.

The proposed reservoirs will develop into much-needed, lake-type fisheries with warm-water qualities. With the likely exception of smallmouth bass, most of the fish species now present in the drainages above the proposed dams will persist in the impoundments. In some cases, the reservoirs will have little effect on the remaining downstream fishery. In other instances, the reservoirs will increase the value of the downstream fishery, especially in the tailwaters below the dam. Basinwide, fishing opportunities will be greatly enhanced. Full development of the basin reservoir plan as previously described has been assumed. Based on that assumption, and assuming mitigation of the more significant losses, the estimated annual net gain in fisherman use of the proposed impoundments and affected stream reaches below the dams will exceed 1,700,000 angler days. The estimated value of the net fishery benefits is about \$2,120,000. (Table 2).

The anticipated angler-day use of the reservoirs and remaining downstream fisheries combined will much more than equal the present use of the stream fisheries. Nevertheless, satisfactory mitigation of fishery losses on high-quality streams, especially in the Meramec and Big River drainages, is considered necessary and will require special effort. Reservoir development will destroy approximately 135 miles of streams now supporting smallmouth bass and other preferred species. This loss will not be compensated in kind by reservoir fisheries. The aesthetics of stream fishing, characterized by moving water meandering through a forest-canopied stream course, cannot be duplicated by a reservoir shoreline. Float fishing is an especially important activity on the Meramec River, one of the few streams remaining in Missouri where this form of recreation can be practiced.

Table 2. Analysis of Fishing Values for 31 Meramec Basin Reservoir Sites

Reservoir Sites	Reservoir Area (Normal Pool)			Downstream Area			Net Change	Total Monetary Benefit ^{1/}
	Without Project	With ^{1/} Project	Difference	Without Project	With ^{2/} Project	Difference		
Riv Subbasin	Annual Fisherman Days			Annual Fisherman Days				
* # 9	2,580	83,580	81,000	20,400	30,600	10,200	91,200	\$ 114,000
# 2A	2,980	202,980	200,000	26,400	39,600	13,200	213,200	213,200
* # 5	3,370	71,400	68,030	2,000	4,000	2,000	70,030	87,540
I-30	560	7,560	7,000	1,760	2,200	440	7,440	7,440
* H-25	60	2,250	2,190	780	980	200	2,390	3,680
H-40	20	3,020	3,000	0	0	0	3,000	2,980
H-4	30	2,530	2,500	10	30	20	2,520	2,520
H-9	70	2,400	2,330	20	350	330	2,660	2,660
H-3	50	4,830	4,780	280	350	70	4,850	4,850
Subtotals	9,720	380,550	370,830	51,650	78,110	26,460	397,290	\$ 438,870
Meramec Riv Subb								
* #27	2,200	67,200	65,000	15,000	22,500	7,500	72,500	\$ 96,980
* #17 w/#40	48,880	535,280	486,400	5,000	10,000	5,000	491,400	737,100
* #17 wo/#40	(48,880)	(535,280)	(486,400)	(18,000)	(36,000)	(18,000)	(504,400)	(756,600)
* #40	14,000	262,000	248,000	18,000	27,000	9,000	257,000	367,000
I-23	120	13,640	13,520	150	190	40	13,560	13,560
I-41	120	4,750	4,630	60	120	60	4,690	7,040
I-28	530	14,400	13,870	300	380	80	13,950	13,950
* I-26	1,000	14,390	13,390	80	400	320	13,710	20,570
* I-14	2,320	15,590	13,270	13,500	20,250	6,750	20,020	30,035
* I-15A	3,400	22,000	18,600	6,000	12,000	6,000	24,600	36,900
I-8	240	5,240	5,000	580	720	140	5,140	5,140
H-5	10	1,800	1,790	0	0	0	1,790	1,790
H-10	20	1,380	1,360	320	600	280	1,640	2,460
Subtotals ^{3/}	72,840	957,670	884,830	58,990	94,160	35,170	920,000	\$1,332,525
Bourbeuse River								
Subbasin								
#29	7,280	247,650	240,370	20,640	30,960	10,320	250,690	250,150
I-38	1,180	21,870	20,690	4,120	8,240	4,120	24,810	24,810
I-35A	2,580	17,810	15,230	0	0	0	15,230	12,750
I-33A	1,380	18,630	17,250	1,500	3,000	1,500	18,750	18,750
I-21	90	4,410	4,320	60	70	10	4,330	6,810
I-32	640	17,500	16,860	240	300	60	16,920	16,920
H-31	20	1,790	1,770	50	60	10	1,780	1,780
H-13	50	6,460	6,410	360	450	90	6,500	6,500
H-11	90	3,740	3,650	220	270	50	3,700	3,700
H-6	90	6,090	6,000	160	200	40	6,040	6,040
Subtotals	13,400	345,950	332,550	27,350	43,550	16,200	348,750	348,210
Grand Totals								
(rounded)	95,960	1,684,170	1,588,210	137,990	215,820	77,830	1,666,040	\$2,119,605

* Indicates wo/the-proj high-quality stream fishery, not replaced in kind by w/the-proj reservoir fishery.

^{1/} Contingent upon adoption of necessary mitigation measures.

^{2/} Includes tailwater fishery below the dam.

^{3/} Includes Site 17 with site 40 in combination.

One acceptable means of obtaining mitigation for losses of high-quality streams is by stream habitat improvement below the reservoirs. Habitat improvement should be used where necessary to improve remaining segments of premium-type streams. Public access to downstream reaches should be improved by providing angler use sites. (See map). Reservoir operations can sometimes be modified to advantage. Downstream flows must be adequate, especially during the drier summer and early fall months, to assure that remaining stream habitat is improved for fish. In some instances, both high and low level outlets will be necessary to provide suitable temperatures for smallmouth bass or other preferred species. Without these or other methods of mitigation there will be substantial and needless losses to existing stream fisheries. Such losses are to be avoided wherever established values are high.

Construction of 31 reservoirs will affect adversely most forms of wildlife within the project areas. Approximately 42,000 acres of wildlife habitat will be inundated and permanently lost. In addition, there will be a partial loss of habitat, with a corresponding decrease in values, on more than 10,000 acres within the zone of fluctuating water levels. Further losses to wildlife will continue for years following project construction. More than 80,000 acres of downstream lands will be protected from future flooding and these lands will become more intensively used, thereby reducing their value to most forms of wildlife.

Deer, turkeys, and several species of upland game and terrestrial fur animals will be reduced in numbers, with losses probably in proportion to the amount of habitat destroyed. Hunting opportunities will decline accordingly. Substantial benefits will accrue to waterfowl and, to a lesser extent, to aquatic fur animals. However, waterfowl benefits must not be used to compensate for anticipated losses to terrestrial forms of wildlife. Unless mitigating measures are incorporated in the plan, we anticipate significant reductions in opportunity to hunt most species of wildlife which are not hunted within most of the reservoir sites. Assuming satisfactory mitigation of these losses, the estimated value of the net wildlife benefits is \$29,000. (Table 3).

The reservoir areas furnish some of the most productive wildlife land in the Ozarks. With extensive reductions in habitat, big game and upland game numbers will decline. Hunting opportunities can be maintained only if public access is provided to all project lands not specifically required for other purposes. A substantial land base should be made available to the Missouri Conservation Commission for wildlife management purposes, including game harvest. In addition, losses at some reservoirs should be mitigated by improving nearby game ranges. Acquisition, development, and management of selected tracts specifically for wildlife will be necessary in some instances to properly mitigate wildlife losses which would otherwise be imposed by the project.

At least two key areas should be acquired for the purposes indicated above. Wildlife losses at Site 17 should be mitigated by acquisition and development of approximately 4,400 acres adjacent to Huzzah Wildlife Area, which is located near the upper end of the proposed Meramec Park Reservoir. Damaging

Table 3. Analysis of Hunting Values for 31 Meramec Basin Reservoir Sites

Reservoir Sites	Reservoir Area			Downstream Area			Net Change	Total Monetary Benefit ^{1/}
	Without Project	With ^{1/} Project	Difference	Without Project	With ^{1/} Project	Difference		
<u>BigRiv Subbasin</u>	<u>Annual Hunter Days</u>			<u>Annual Hunter Days</u>				
# 9	216	1,000	784	492	246	-246	538	\$ 1,610
# 2A	600	840	240	480	240	-240	0	0
# 5	140	360	220	20	10	- 10	210	210
I-30	22	200	178	60	30	- 30	148	440
H-25	8	100	92	16	8	- 8	84	250
H-40	4	50	46	16	8	- 8	38	130
H-4	12	50	38	0	0	0	38	110
H-9	8	50	42	12	6	- 6	36	110
H-3	20	100	80	34	17	- 17	63	190
Subtotals	1,030	2,750	1,720	1,130	565	-565	1,155	\$ 3,050
<u>MeramecRiv Subb</u>								
#27	190	750	560	160	80	- 80	480	1,440
#17	994	4,250	3,256	20	10	- 10	3,246	9,740
#40	450	1,250	800	88	44	- 44	756	3,620
I-23	40	150	110	16	8	- 8	102	310
I-41	40	150	110	20	10	- 10	100	300
I-28	80	250	170	4	2	- 2	168	500
I-26	45	250	205	0	0	0	205	620
I-14	40	240	200	16	8	- 8	192	490
I-15A	45	250	205	20	10	- 10	195	590
I-8	12	200	188	20	10	- 10	178	570
H-5	4	100	96	0	0	0	96	290
H-10	6	100	94	8	4	- 4	90	190
Subtotals	1,946	7,940	5,994	372	186	-186	5,808	\$18,660
<u>Bourbeuse River Subbasin</u>								
#29	950	2,300	1,350	184	92	- 92	1,258	3,770
I-38	130	400	270	92	46	- 46	224	670
I-35A	134	300	166	0	0	0	166	500
I-33A	120	300	180	20	10	- 10	170	510
I-21	58	100	42	16	8	- 8	34	100
I-32	160	400	240	28	14	- 14	226	680
H-31	15	50	35	12	6	- 6	29	90
H-13	38	150	112	64	32	- 32	80	240
H-11	20	100	80	20	10	- 10	70	210
H-6	22	100	78	4	2	- 2	76	230
Subtotals	1,647	4,200	2,553	440	220	-220	2,333	\$ 7,000
Grand Totals	4,623	14,890	10,267	1,942	971	-971	9,296	\$28,710

^{1/} Contingent upon adoption of necessary mitigation measures.

effects to wildlife from those basin reservoirs within the outer limits of Clark National Forest can be mitigated by acquiring approximately 4,000 acres of selected lands situated between the project sites and nearby National Forest tracts. This will assist greatly in "blocking out" larger tracts in Federal ownership and make these areas much more effective in any wildlife management plan for these areas.

CONCLUSIONS

The previous tables are based on data provided from your office through September 1963. They summarize estimated fishing and hunting use for the 31 reservoir sites, with and without the project. We wish to emphasize, however, that benefits indicated are largely incidentally created. In the case of fish, substantial benefits will accrue in the reservoirs, but at the expense of existing stream fisheries. In the case of wildlife, most benefits indicated have been derived from an anticipated increase in waterfowl use. This will tend to increase total hunting opportunity, but at the expense of the big game and upland game hunters now using these areas. The increase in waterfowl hunting opportunities will not compensate for resident game hunting losses.

The net benefits indicated are based on the assumption that mitigation of the more significant losses is necessary and will be accomplished for both the stream fisheries and the wildlife.

Any truly comprehensive plan of development for the Meramec Basin should contain provisions for safeguarding established fish and wildlife resources. Because of the preliminary status of planning for this project, any recommendations must remain somewhat indefinite. Specific measures for mitigation or enhancement of these resources will be provided later. The following recommendations should suffice until more detailed water development plans become available.

RECOMMENDATIONS

It is recommended that:

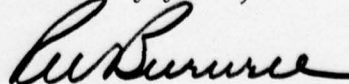
1. All project lands be acquired in fee title up to maximum flood pool at each reservoir, in accordance with the 1962 Joint Policy of the Departments of the Interior and the Army Relative to Reservoir Project Lands, in order that these lands may be developed and intensively managed for wildlife.
2. Selected lands in addition to those required for primary project purposes, including 4,400 acres adjacent to Huzzah Wildlife Management Area and approximately 4,000 acres within the outer boundaries of Clark National Forest, be acquired to mitigate project-incurred wildlife losses.
3. Selected project lands and waters, be made available to the Missouri Conservation Commission under terms of a General Plan, as provided for by Sections 3 and 4 of the Fish and Wildlife Coordination Act.

4. Multiple-level outlets be included in any design plans for dams at major and intermediate sites.
5. Reservoir zoning plans be developed in connection with overall planning for the reservoirs to insure that certain areas (or certain periods) will be available for fishing, hunting, and other wildlife purposes, without conflicting uses from other forms of recreation. It is further recommended that the reservoir zoning plan be developed cooperatively by the Missouri Conservation Commission, Corps of Engineers, the Bureau of Sport Fisheries and Wildlife, the Bureau of Outdoor Recreation, and other affected agencies.
6. Public access be provided to all reservoirs, reservoir tailwaters, selected downstream areas and to all levees of the lower Meramec River.
7. Prior to establishment of clearing specifications, conferences be held between representatives of interested agencies to formulate mutually acceptable plans for reservoir clearing.
8. Rough fish populations upstream from damsites be reduced prior to dam closure wherever practicable and that project operations allow for continued control of rough fish.
9. Federal lands and project waters in the project area, including lands placed under lease agreements, be open to public use for hunting and fishing so long as title to the lands and structures remains in the Federal Government, except for sections reserved for safety, efficient operation, or protection of public property.
10. Additional detailed studies of fish and wildlife resources be conducted, as necessary, after the project is authorized, in accordance with Section 2 of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq); and that such reasonable modifications be made in the authorized project facilities as may be agreed upon by the Director of the Bureau of Sport Fisheries and Wildlife and the Chief of Engineers, for the conservation, improvement, and development of these resources.

Please keep us informed of any changes in the status of this project so that we may conduct timely studies and provide a more detailed analysis of expected project effects upon fish and wildlife.

This opportunity to work closely with members of your staff in planning jointly with yours and other agencies in the comprehensive development of Meramec Basin is appreciated. We expect to continue to assist you in your planning efforts as the studies progress.

Sincerely yours,



R. W. Burwell
Regional Director

MISSOURI CONSERVATION COMMISSION

Highway 50 West

TElephone 636-8141

Jefferson City, Missouri

William E. Towell, Director

January 22, 1964

Mr. Robert W. Burwell, Regional Director
Bureau of Sport Fisheries and Wildlife
Fish and Wildlife Service, USDI
1006 West Lake Street
Minneapolis 8, Minnesota

Attention: Mr. Charles Chambers

Dear Mr. Burwell:

On January 22, 1964, Mr. Charles Chambers was in this office for the purpose of reviewing a draft letter report on wildlife in the Meramec Basin, which will be submitted to the Corps of Engineers, St. Louis, to meet a January 30, 1964 deadline.

The report was reviewed by Mr. Chambers in this office with Messrs. Gale, Barnickol, Dunkeson, and Noren. The report was edited and I have reviewed the edited draft as it was revised on January 22, 1964, in Jefferson City.

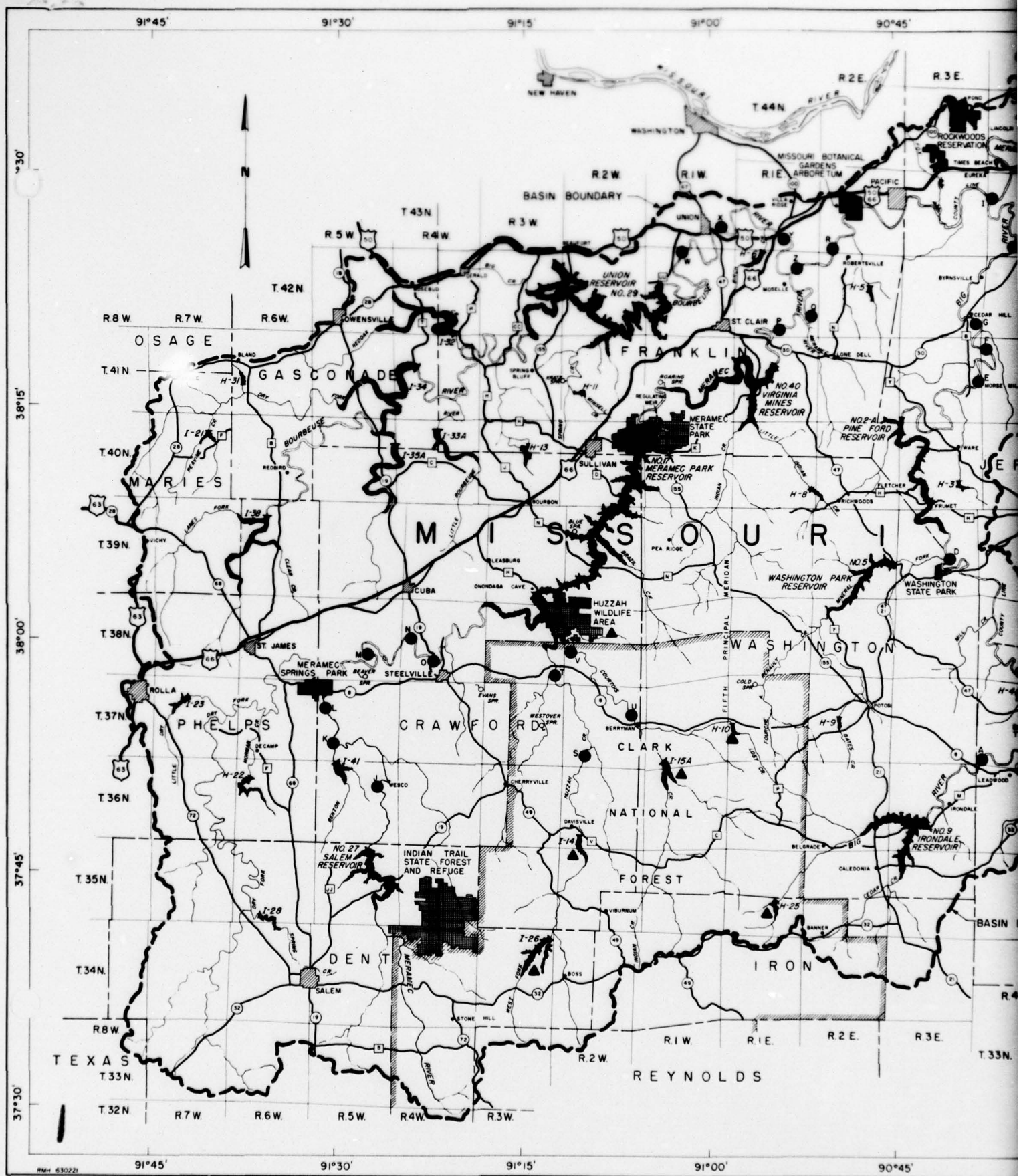
Mr. Chambers returned to Minneapolis with a revised draft, and it is my understanding that it is this revised draft which will be sent to the Corps of Engineers. I concur in this revised draft of the letter report.

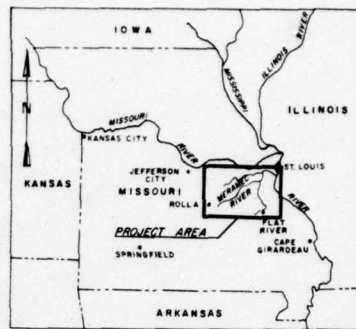
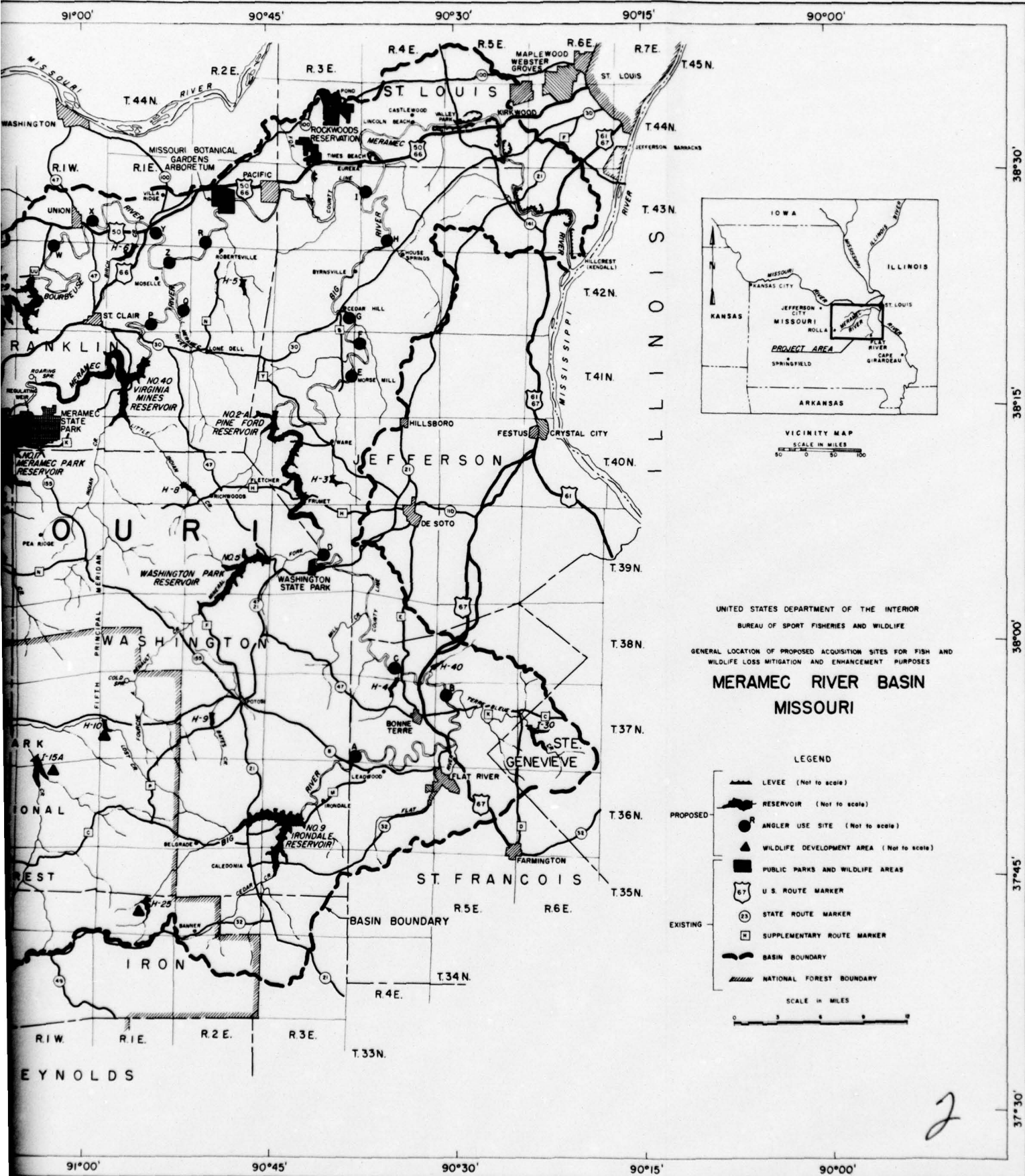
Thank you for the opportunity to review the report.

Sincerely,

Sgd. William E. Towell

WILLIAM E. TOWELL
DIRECTOR





VICINITY MAP
SCALE IN MILES
0 50 100

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF SPORT FISHERIES AND WILDLIFE
GENERAL LOCATION OF PROPOSED ACQUISITION SITES FOR FISH AND
WILDLIFE LOSS MITIGATION AND ENHANCEMENT PURPOSES

MERAMEC RIVER BASIN MISSOURI

LEGEND

- PROPOSED
- LEVEE (Not to scale)
 - RESERVOIR (Not to scale)
 - ANGLER USE SITE (Not to scale)
 - WILDLIFE DEVELOPMENT AREA (Not to scale)
 - PUBLIC PARKS AND WILDLIFE AREAS
 - U.S. ROUTE MARKER
 - STATE ROUTE MARKER
 - SUPPLEMENTARY ROUTE MARKER
- EXISTING
- BASIN BOUNDARY
 - NATIONAL FOREST BOUNDARY

SCALE IN MILES



2

COMPREHENSIVE REPORT
MERAMEC RIVER BASIN,
MISSOURI

APPENDIX P
EFFECT ON CAVES

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COMPREHENSIVE REPORT
MERAMEC RIVER BASIN, MISSOURI

APPENDIX P

EFFECT ON CAVES

SECTION I - INTRODUCTION

1. GENERAL

This appendix discusses the effects of the proposed reservoir system on the principal caves which are major natural attractions of the area. These caves have been commercially developed by private interests and enjoy a large number of visitors each year. The investigation was made by the Corps of Engineers at the request of the Bureau of Outdoor Recreation. FIGURES P-2, P-3, P-4, and P-6 have been taken from "Caves of Missouri" by the Missouri Division of Geological Survey and Water Resources.

SECTION II - COMMERCIALY DEVELOPED CAVES

2. FISHER CAVE

Fisher Cave is located in Meramec State Park on the west side of the Meramec River valley. The cave is about 1 mile downstream of the Meramec Park Reservoir dam and is at the head of the Virginia Mines Reservoir, as shown on FIGURE P-1.

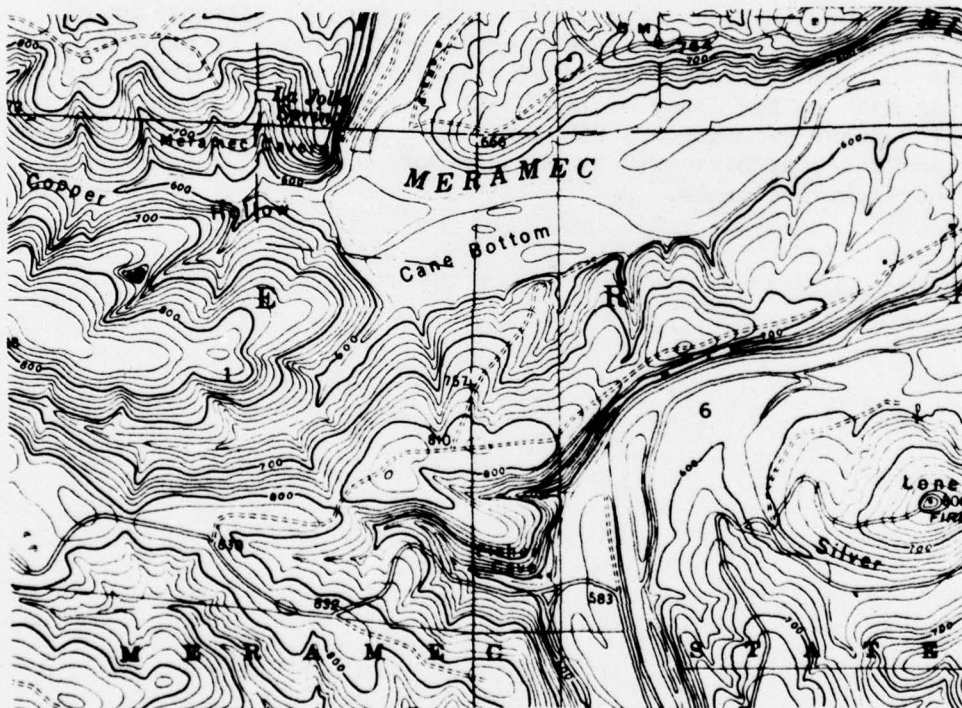


FIG. P-1 LOCATION MAP-MERAMEC AND FISHER CAVES

Virginia Mines has no flood control storage. Top of multiple-purpose pool is 556 feet m.s.l., which is within the banks of the river at Fisher Cave. The entrance to Fisher Cave is at 590 feet m.s.l., or about 34 feet above Virginia Mines top pool. From this point, the cave slopes upward from the entrance, with the high point being about elevation 670 feet m.s.l. See FIGURE P-2.

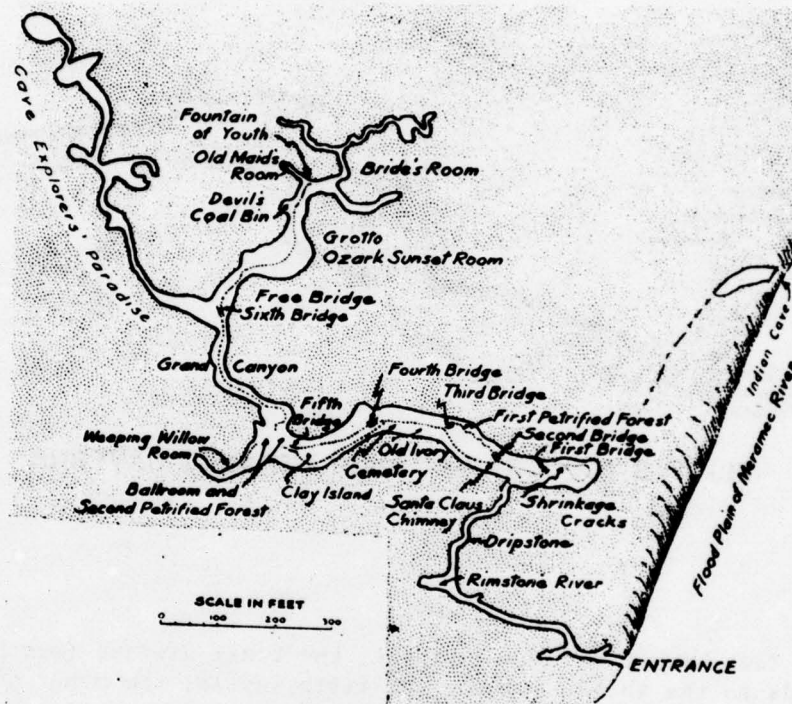


FIG. P-2 PLAN OF FISHER CAVE

Development of hydropower by pump back storage has not been found feasible at the present time at Meramec Park. Should it become feasible at a later date, the auxiliary impoundment would be sealed against any leakage which might affect the cave. The camping and picnic area near the entrance to Fisher Cave will not be inundated, as almost all of this area is above elevation 580 feet m.s.l. The information available indicates that neither Fisher Cave nor the nearby recreation area will be affected by either Virginia Mines or Meramec State Park Reservoirs.

3. MERAMEC CAVERNS

Meramec Caverns is located in the base of the western bluff of the Meramec River valley. See FIGURE P-1. The cave is about 20 miles upstream of the Virginia Mines dam, which will have a top pool elevation of 556 feet m.s.l. The entrance to the cave is at elevation 585 feet m.s.l., into what is really the second level of the cave. Topography of the entrance chamber is shown on FIGURE P-3.

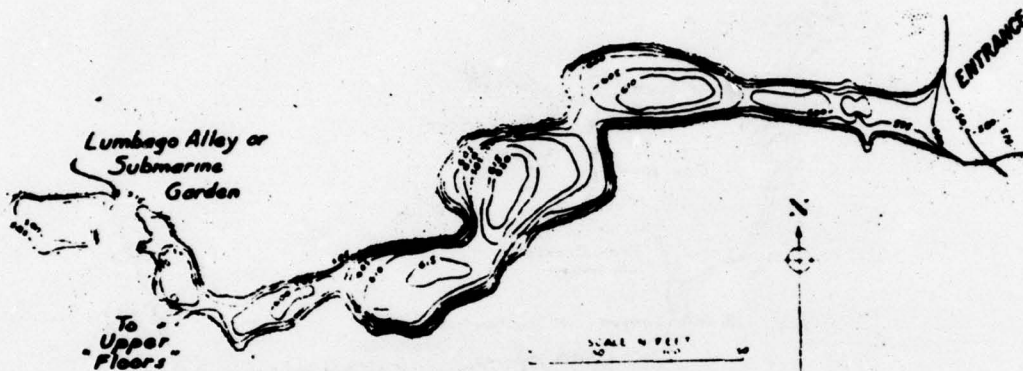


FIG. P-3 TOPOGRAPHIC MAP-MERAMEC CAVERNS

About 450 feet back from this entrance, the trail divides (see FIGURE P-4). One ascends to the third, fourth, and fifth levels; the other descends to the lower or first level.

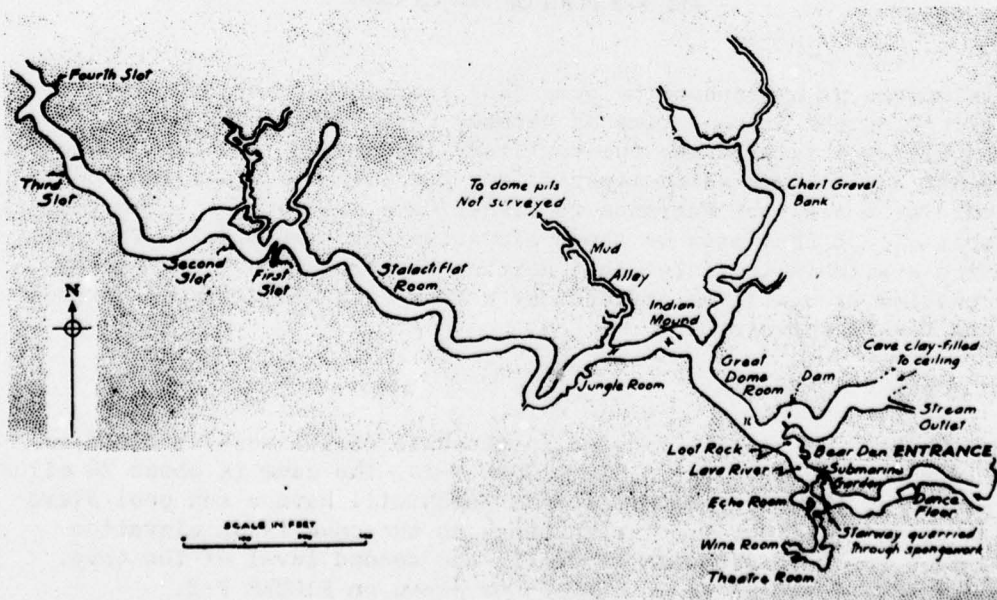


FIG. P-4 PLAN OF MERAMEC CAVERNS

The lower level is reached by descending through a long, narrow passage, which at one point drops to elevation 575 feet m.s.l. in the "Submarine Garden". This level contains the cave stream which exits to the north of and 20 feet lower than the entrance chamber floor. At least twice in this century (1945 and 1950), this lower level was flooded and 3 to 4 feet of water were reported in the cave entrance chamber. On the flood plain north of the cave, there is an area of approximately 30 acres developed as a picnic and camping area called La Jolla Park. Most of this area is between elevations 565 and 578 feet m.s.l.; therefore, it will be above the top elevation of Virginia Mines Reservoir. Buildings and parking lots related to the cave operation would not be subject to inundation by the reservoir. None of Meramec Caverns and little of the recreation area around it are affected by Virginia Mines Reservoir. Since the cave is downstream of Meramec Park dam, it will benefit from any flood control measures provided by that reservoir.

4. ONONDAGA CAVE

Onondaga Cave is located about 20 miles upstream of the Meramec Park dam (top of flood control pool elevation 701 m.s.l.) on the northern side of the Meramec River valley. See FIGURE P-5.



FIG. P-5 LOCATION MAP-ONONDAGA CAVE

At one time, part of this cave was under different ownership and was known as "Missouri Caverns". The cave is entered from an artificial entrance at elevation 650.0 feet m.s.l. A flight of steps leads to the old boat dock (elevation 648 feet m.s.l.), abandoned since boat trips into the cave from the natural entrance ceased. From this point on, the floor is more or less level (elevation 655.0+) for about 600 feet into the "Big Room". In the "Big Room", the trail divides. The trail to the right leads to the upper level and the "Walls of Jericho" formation. The elevation of this trail varies from 650 to 703 feet m.s.l.; the ceiling is level at about elevation 708.0 feet m.s.l. The trail to the left leads past "The Twins" formation to the old "Missouri Caverns". This trail starts at elevation 650 feet m.s.l. and rises to approximately elevation 703 feet m.s.l.; it then levels off for about 800 feet at which point the cave ends. The ceiling in this section varies from elevation 720 feet m.s.l. in the "Big Room" to elevation 733 feet m.s.l. at the end of the cave. See FIGURE P-6.

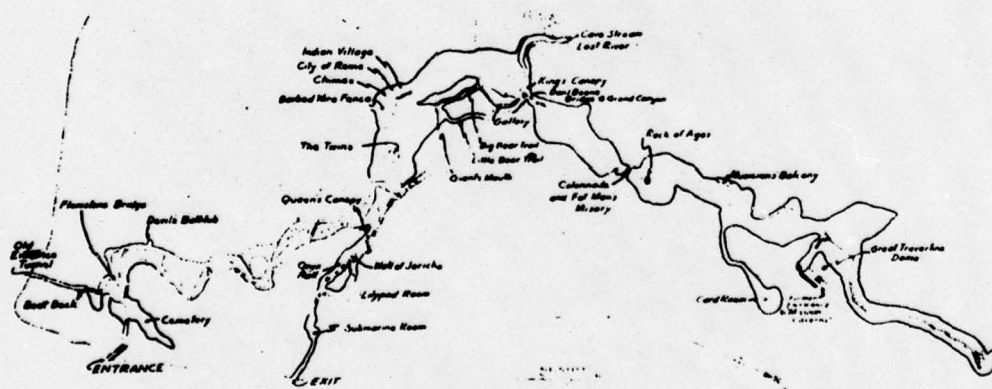


FIG. P-6 PLAN OF ONONDAGA CAVE

The restaurant-gift shop building is located on the hill overlooking the reservoir at about elevation 705 feet m.s.l. There is a man-made lake located at the natural cave entrance (elevation 646 feet m.s.l.), with a small picnic area nearby. The normal pool elevation of the Meramec Park Reservoir is 667.0 feet m.s.l. so the lower level of the cave will be permanently inundated by about 20 feet of water. The

top of the flood control pool, elevation 701.0 feet m.s.l., will flood at least 60 percent of the cave trails, the exception being the upper level of the "Missouri Caverns" section. This area is above the flood control pool and has an existing entrance at elevation 740.0 feet m.s.l. The area around the restaurant-office building will be above top of flood control pool, but all picnic areas lower than this would be flooded at top of flood control pool of Meramec Park Reservoir, elevation 701.0 feet m.s.l.

SECTION III - VIEWS OF OWNER

5. VIEWS OF OWNER

Mr. Lester Dill, owner of both Meramec Caverns and Onondaga Cave, has stated that he has sufficient portions of the caves which have been explored, but are not now in use, to make the loss of the lower level of Onondaga Cave of no consequence to him as operator. The inundation of this lower level would merely require the opening to the public of upper levels of the cave not now in use, or opening of some of the 14 other caves in the same general area.

SECTION IV - SUMMARY

6. SUMMARY

Since no deleterious effect will be suffered by the major caves of the Meramec Basin from the proposed system of reservoirs other than the flooding of the lower level of Onondaga Cave, which is acceptable to the owner, it is considered that the major cave attraction situation presents no problem to the economy and scenic attraction of the basin due to operation of the proposed reservoirs.

COMPREHENSIVE REPORT

MERAMEC RIVER BASIN,
MISSOURI

APPENDIX Q

FLOOD CONTROL ECONOMICS

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Plate No.

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COMPREHENSIVE REPORT
MERAMEC RIVER BASIN, MISSOURI

APPENDIX Q

FLOOD CONTROL ECONOMICS

SECTION I - INTRODUCTION

1. SCOPE

A description of existing and prospective development in the Meramec River flood plain is presented in this appendix. Also presented is the evaluation of the effect that flooding has now and will have on development in the future. As such, information and data given herein constitute the background economics necessary to the derivation of flood control benefits presented in APPENDIX R.

SECTION II - FLOOD PLAIN DEVELOPMENT, PRESENT CONDITIONS

2. GENERAL

Approximately 5 percent of the total land in the basin lies in the flood plains, which vary in width from 1/2 mile to 1 mile in the lower reaches of the basin and become progressively narrower toward the headwaters. About 61 percent of the flood plain is in crops and pasture, 36 percent in timber and wasteland, and 3 percent in urban or recreational housing use. Most of the urban and recreational housing areas are located downstream from Pacific (mile 49.0) although there are some state parks, caves, commercial resorts, and recreational housing located in the flood plains upstream and on the Big and Bourbeuse Rivers.

3. AGRICULTURAL DEVELOPMENT

The soils in the bottoms are mostly Huntington-type, Class I, and, in general, are fertile, well drained, and easily tilled. Since farming is primarily a livestock economy, corn and hay crops predominate. Wheat, soybeans, lespedeza and oats are also grown. The average size of the farms is approximately 300 acres of which 70 to 80 acres are in the bottoms. The remainder of the farm is generally not suitable to growing grain crops but contains open pasture, timber pasture, and timber. Under these conditions, the bottom land acres are the "life blood" of the farm and as such are intensively cultivated. Resulting yields are usually high.

4. RURAL NON-AGRICULTURAL DEVELOPMENT

The farm sets for most farms with bottom land acreage are located outside of the flood plains. Those in the flood plains are located at high levels. Due to the proximity of the lower reaches of Meramec River to urban centers within the St. Louis metropolitan area and the use of the river by that population for recreational purposes, there is an extensive highway network of all-weather roads within the bottoms in those reaches. Railroad lines traversing a substantial portion of the bottoms are on raised roadbeds.

5. URBAN DEVELOPMENT

All or portions of the towns of Fenton, Valley Park, Glencoe, Times Beach, Pacific, and Cedar Hill are located in the flood plain. Development within the flood plain consists of the following:

- a. Fenton, mile 15.8. Fifty residences ranging in value from \$3,000 to \$15,000 per home and several commercial establishments.
- b. Valley Park, mile 22.0. Seven major industries, 41 commercial establishments, and 290 residences ranging in value from

\$3,000 to \$18,000 per home. The industries manufacture reinforced concrete pipe, precision metal forgings, resins for use in paints, concrete blocks, cotton and gauze products, metal stampings, and wooden ladders.

c. Glencoe, mile 30.9. Thirteen homes and a grocery store.

d. Times Beach, mile 34.0. Two hundred and fifty residences ranging in value from \$2,000 to \$15,000 per home.

e. Pacific, mile 49.0. Thirty-five homes ranging in value from \$7,000 to \$20,000 per home.

f. Cedar Hill, mile 19.9, Big River. Three homes and an ice plant.

In addition, there are numerous scattered residences and commercial establishments located in the bottoms, mostly within St. Louis and Jefferson Counties.

6. CLUBHOUSE DEVELOPMENT

There are some 2,100 recreational housing units, locally referred to as "clubhouses" located along the rivers and creeks throughout Meramec River Basin. The majority of these units is concentrated within short time travel distance from urban centers in the metropolitan St. Louis area. Few new units have been added in the past two decades. These clubhouses were constructed primarily for weekend recreational occupancy; however, there has been an increasing use of them in recent years as low-cost permanent housing.

7. RECREATIONAL DEVELOPMENT

In addition to the clubhouse areas, development for recreational purposes exists at Meramec Caverns, Onondaga Cave, and Meramec State Park on the Meramec River, and Washington State Park on the Big River. While the bathing, fishing, and boating facilities of recreational lodge and cabin groups are within the flood plains, the major development is generally located on higher ground above flood levels.

SECTION III - FLOOD DAMAGES, PRESENT CONDITIONS

8. FLOOD PROBLEM

Major Meramec River floods have occurred, on the average, about every 6 years. However, portions of the bottoms have experienced flooding almost annually. Since most of the bottom land use is in crops, and since most other development is subject to less frequent flooding, more than half of the average annual damage occurs to crops. Although the farmer's bottom land acreage averages but about one-quarter of his total farm area, flood damage to this area is significant since it usually represents his sole source of crop income. High property damage occurs to other development during major floods. It is estimated that a recurrence of the 1915 flood, the highest of record, would presently cause about \$8,000,000 damage, of which about \$5,000,000 would be non-crop damage.

9. DAMAGE REACHES

For purposes of determining flood damages, damage reaches were established on the three major streams and on all tributaries on which plans of improvement were considered. These are as listed in TABLE Q-1 and shown on PLATE Q-1.

TABLE Q-1
Damage reaches - Meramec River Basin

<u>Reach</u>	<u>Mile</u>		<u>Description</u>
	<u>From</u>	<u>To</u>	
MAIN STEM, MERAMEC RIVER			
1	0.0	10.8	Mouth of Meramec River to 0.5 mile above Missouri State Highway 21 bridge
2	10.8	37.5	0.5 mile above State Highway 21 bridge to mouth Big River
3	37.5	58.3	Mouth of Big River to mouth of Calvey Creek
4	58.3	64.8	Mouth of Calvey Creek to mouth of Bourbeuse River
5	64.8	82.4	Mouth of Bourbeuse River to Virginia Mines Damsite
6	82.4	97.0	Virginia Mines Damsite to 10.5 miles below Meramec Park Damsite
7	97.0	107.5	10.5 miles below Meramec Park Damsite to Meramec Park Damsite
8	107.5	135.1	Meramec Park Damsite to 4.6 miles below mouth of Huzzah Creek

TABLE Q-1 (Cont'd)

<u>Reach</u>	<u>Mile</u>		<u>Description</u>
	<u>From</u>	<u>To</u>	
9	135.1	146.0	4.6 miles below mouth of Huzzah Creek to mouth of Whittenburg Creek
10	146.0	167.8	Mouth of Whittenburg Creek to mouth of Dry Fork Creek
11	167.8	191.6	Mouth of Dry Fork Creek to Salem Damsite
MAIN STEM, BIG RIVER			
12	0.0	28.4	Mouth of Big River to below mouth of Dry Creek
13	28.4	43.3	Below mouth of Dry Creek to Pine Ford Damsite
14	43.3	58.8	Pine Ford Damsite to 1.8 miles below mouth of Mineral Fork Creek
15	58.8	63.0	1.8 miles below mouth of Mineral Fork Creek to 2.4 miles above mouth of Mineral Fork Creek
16	63.0	78.5	2.4 miles above mouth of Mineral Fork Creek to 3.0 miles below mouth of Cabanne Course Creek
17	78.5	86.7	3.0 miles below mouth of Cabanne Course Creek to 1.1 miles below mouth of Terre Bleue Creek
18	86.7	116.5	1.1 miles below mouth of Terre Bleue Creek to Irondale Damsite
19	116.5	123.9	Irondale Damsite to 8.3 miles below H-25 Damsite
20	123.9	132.2	8.3 miles below H-25 Damsite to H-25 Damsite
MAIN STEM, BOURBEUSE RIVER			
21	0.0	6.1	Mouth of Bourbeuse River to mouth of Birch Creek
22	6.1	31.6	Mouth of Birch Creek to Union Damsite
23	31.6	39.4	Union Damsite to below mouth of Spring Creek
24	39.4	70.1	Below mouth of Spring Creek to 6.1 miles below mouth of Boone Creek
25	70.1	74.0	6.1 miles below mouth of Boone Creek to 2.2 miles below mouth of Boone Creek
26	74.0	78.2	2.2 miles below mouth of Boone Creek to 2.0 miles above mouth of Boone Creek

TABLE Q-1 (Cont'd)

<u>Reach</u>	<u>Mile</u>		<u>Description</u>
	<u>From</u>	<u>To</u>	
27	78.2	88.4	2.0 miles above mouth of Boone Creek to 1.5 miles below mouth of Little Bourbeuse River
28	88.4	92.0	1.5 miles below mouth of Little Bourbeuse River to 2.1 miles above mouth of Little Bourbeuse River
29	92.0	105.3	2.1 miles above mouth of Little Bourbeuse River to mouth of Brush Creek
30	105.3	127.3	Mouth of Brush Creek to I-38 Damsite

TRIBUTARY REACHES

<u>Stream</u>			
Fenton Creek	0	3.3	Mouth of Fenton Creek to mile 3.3 on Fenton Creek
Grand Glaize Creek	0	2.7	Mouth of Grand Glaize Creek to mile 2.7 on Grand Glaize Creek
Calvey Creek	0	5.0	Mouth of Calvey Creek to mouth of Brady Creek
Brady Creek	0	0.2	Mouth of Brady Creek to H-5 Damsite
Indian Creek	0	2.7	Mouth of Indian Creek to mouth of Little Indian Creek
Little Indian Creek	0	7.4	Mouth of Little Indian Creek to H-8 Damsite
Courtois Creek	0	18.8	Mouth of Courtois Creek to I-15A Damsite
Lost Creek	0	8.2	Mouth of Lost Creek to H-10 Damsite
Huzzah Creek	0	24.7	Mouth of Huzzah Creek to I-14 Damsite
Dry Fork Creek (Meramec River Trib.)	0	52.9	Mouth of Dry Fork Creek to mouth of Spring Creek
Spring Creek (Meramec River Trib.)	0	2.0	Mouth of Spring Creek to I-28 Damsite
Little Dry Fork Creek	0	3.9	Mouth of Little Dry Fork to I-23 Damsite
Benton Creek	0	0.9	Mouth of Benton Creek to I-41 Damsite
Terre Bleue Creek	0	11.6	Mouth of Terre Bleue Creek to I-30 Damsite

TABLE Q-1 (Cont'd)

<u>Stream</u>	<u>Mile</u>		<u>Description</u>
	<u>From</u>	<u>To</u>	
Dry Creek	0	7.5	Mouth of Dry Creek to H-3 Damsite
Cabanne Course Creek	0	0.8	Mouth of Cabanne Course Creek to H-4 Damsite
Mineral Fork Creek	0	24.1	Mouth of Mineral Fork Creek to mouth of Bates Creek
Bates Creek	0	2.7	Mouth of Bates Creek to H-9 Damsite
Brush Creek	0	2.5	Mouth of Brush Creek to I-35A Damsite
Spring Creek (Bourbeuse River Trib.)	0	10.1	Mouth of Spring Creek to mouth of Winsel Creek
Winsel Creek	0	1.0	Mouth of Winsel Creek to H-11 Damsite
Boone Creek	0	10.8	Mouth of Boone Creek to H-13 Damsite
Redoak Creek	0	2.1	Mouth of Redoak Creek to I-32 Damsite
Little Bourbeuse River	0	5.1	Mouth of Little Bourbeuse River to I-33A Damsite
Dry Fork Creek (Bourbeuse River Trib.)	0	19.9	Mouth of Dry Fork Creek to mouth of Peavine Creek
Peavine Creek	0	1.5	Mouth of Peavine Creek to I-21 Damsite
Unnamed tributary of Dry Fork Creek	0	1.1	Mouth of tributary to H-31 Damsite
Birch Creek	0	1.3	Mouth of Birch Creek to H-6 Damsite

10. ACREAGES SUBJECT TO FLOODING

There are approximately 129,400 acres of land downstream from the uppermost considered damsites that are subject to flooding. Of this amount, about 10,500 acres in the lower portion of Meramec River are subject to flooding by Mississippi River backwater. Approximately 79,300 acres of the 129,400 acres are in crops and pasture, 3,800 acres are in urban and recreational use and 46,300 acres are in timber or other use. The above land use distribution was obtained from flood plain land use maps contained in APPENDIX B for the major portion of the watershed, and from additional land use maps developed by use of aerial photographs and U. S. Geological Survey quadrangle sheets for the remainder of the basin. Land use distribution by damage reach in acres and in percent is given in TABLE Q-2.

TABLE Q-2
Acreages subject to flooding - present conditions, Meramec River Basin

	Damage reach	Crop and pasture	Urban and recreation	Timber and other	Total acres
		Acres %	Acres %	Acres %	
MERAMEC RIVER & TRIBUTARY STREAMS					
	1	1,810 39	690 15	2,140 46	4,640
	2	7,260 58	1,550 12	3,690 30	12,500
	3	6,060 64	240 3	3,100 33	9,400
	4	1,330 60	70 3	820 37	2,220
	5	2,800 49	140 2	2,810 49	5,750
	6	1,910 54	20 0*	1,620 46	3,550
	7	450 27	20 1	1,180 72	1,650
	8	2,080 42	120 2	2,750 56	4,950
	9	1,490 65	50 3	740 32	2,280
	10	2,030 60	80 2	1,290 38	3,400
	11 (1)	3,680 69	150 3	1,470 28	5,300
Fenton Creek		0 0	50 100	0 0	50
Grand Glaize Creek		0 0	0 0	20 100	20
Calvey-Brady Creeks		810 84	0 0	160 16	970
Indian-Little Indian Creeks		1,140 66	0 0	600 34	1,740
Courtois Creek		1,340 61	10 0*	850 39	2,200
Lost Creek		610 82	0 0	130 18	740
Huzzah Creek		3,540 68	20 0*	1,640 32	5,200
Dry Fork-Spring Creeks		5,810 85	10 0*	980 15	6,800
Little Dry Fork Creek		240 89	0 0	30 11	270
Subtotal		44,390 60	3,220 5	26,020 35	73,630
BIG RIVER AND TRIBUTARY STREAMS					
	12	6,180 77	320 4	1,500 19	8,000
	13	2,080 71	40 2	800 27	2,920
	14	1,460 58	30 2	1,010 40	2,500
	15	420 60	20 3	260 37	700
	16	1,030 53	30 1	890 46	1,950
	17	570 48	10 1	600 51	1,180
	18	2,050 45	20 0*	2,530 55	4,600
	19	610 65	0 0	330 35	940
	20	250 52	0 0	230 48	480
Terre Bleue Creek		700 56	10 1	530 43	1,240
Dry Creek		460 75	0 0	150 25	610
Cabanne Course Creek		20 50	0 0	20 50	40
Mineral Fork-Bates Creeks		1,970 73	10 0*	720 27	2,700
Subtotal		17,800 64	490 2	9,570 34	27,860
BOURBEUSE RIVER & TRIBUTARY STREAMS					
	21	700 69	30 3	290 28	1,020
	22 (2)	2,930 49	50 1	3,020 50	6,000
	23	440 41	0 0	630 59	1,070
	24	2,980 55	10 0*	2,460 45	5,450
	25	260 54	0 0	220 46	480
	26	360 52	0 0	330 48	690
	27	800 59	10 1	540 40	1,350
	28	530 66	0 0	270 34	800
	29	1,010 63	0 0	590 37	1,600
	30 (3)	2,480 64	0 0	1,420 36	3,900
Spring-Winsel Creeks		770 71	0 0	310 29	1,080
Boons Creek		870 79	0 0	230 21	1,100
Redoak Creek		220 88	0 0	30 12	250
Little Bourbeuse River		380 84	0 0	70 16	450
Dry Fork-Peavine Creeks		2,340 87	0 0	360 13	2,700
Subtotal		17,070 61	100 0*	10,770 39	27,940
Total		79,260 61	3,810 3	46,360 36	129,430
(Say)		79,300	3,800	46,300	129,400

* Percentages are zero when rounded to the nearest 1 percent.

(1) Acreage on Benton Creek below I-41 Damsite is included in Reach 11.

(2) Acreage on Birch Creek below H-6 Damsite is included in Reach 22.

(3) Acreage on Brush Creek below I-35A is included in Reach 30.

11. CLASSIFICATION OF FLOOD DAMAGES

Tangible and intangible damages have been considered herein. Tangible damages consist of physical losses attributable to flooding, together with business losses resulting from decreased production, loss of wages, and cost of emergency operations and flood fight. Intangible damages include loss of life and detrimental effects to health and normal operations, for which no monetary values have been determined for this report. Tangible damages include those which occur to farmers for increased production costs or a reduction or complete loss of expected income from cropland. Also evaluated are rural non-agricultural damages which consist of flood damages to farmhouses, barns, farm equipment, fences, loss of livestock, and erosion on farmland. Losses were estimated for industrial and commercial development with a breakdown to buildings, inventory, machinery, loss of business, loss of wages, and cost of flood fight. Residential and clubhouse damages were determined for the buildings and their contents. Damages were also estimated for flooding of roads, pavements, railroad tracks and embankments, bridges, and fords. It is recognized that floods cause some damage to municipal and public utilities, and are the cause of re-routing of traffic, but these damages were considered to be insignificant and were therefore not evaluated.

12. AGRICULTURAL DAMAGES

a. Farming characteristics. As previously discussed in paragraph 3 of this appendix, bottom land acreage is intensively cultivated and yields are high. Discussions with farmers, county extension agents, and University of Missouri professors of agriculture with knowledge of the Meramec Basin indicate that phenomenal increases in yields have been experienced in the bottoms in the past several years as in many other areas of the United States. An extensive interview survey of 1961 flood-free crop yields and crop distribution was made in the spring and summer of 1962. Farmers cultivating approximately 22 percent of the areas subject to flooding were interviewed. As might be expected, highest yields were generally found in the lowermost reaches of the river and became progressively less in an upstream direction with the smallest yields being obtained on the smallest tributaries. The accuracy of yield indications obtained was discussed with the Department of Agriculture's Extension Agents in each county. Based upon their knowledge of the farmers' operations, they verified yield estimates in many instances and considered them all to be reasonable. It became evident that 1961 was an extremely good crop year. Based upon discussions with the agents and subsequent analyses on future yield indications, it was determined that the 1961 yields were significantly high compared to average yields that might be expected for that year. As a result, summary yield indications were reduced by approximately 20 percent of the total for corn, wheat, and soybeans, and 14 percent for hay. Resulting yields and distributions for the various crops grown in each damage reach are shown in TABLE Q-3. Oats and other small grains are included with wheat.

TABLE Q-3
Yields and percent cropland distribution* - present conditions, Meramec River Basin

Damage reach	Corn		Wheat		Soybeans		Hay		Lespedeza	
	%	Bu/Ac	%	Bu/Ac	%	Bu/Ac	%	Tons/Ac	%	Tons/Ac
MERAMEC RIVER & TRIBUTARY STREAMS										
1	50	80	10	35	40	30	-	-	-	1.5
2	56	80	17	35	20	30	7	3.5	-	1.5
3	55	90	19	35	11	30	15	2.5	-	1.5
4	62	80	7	35	6	30	25	3.5	-	1.5
5	62	80	7	35	6	30	25	3.5	-	1.5
6	62	80	7	35	6	30	25	3.5	-	1.5
7	62	80	7	35	6	30	25	3.5	-	1.5
8	49	80	3	30	2	30	46	3.0	-	1.5
9	49	80	3	30	2	30	46	3.0	-	1.5
10	49	80	3	30	2	30	46	3.0	-	1.5
11	49	80	3	30	2	30	46	3.0	-	1.5
Calvey-Brady Creeks	86	70	-	-	-	-	14	3.5	-	-
Indian-Little Indian Creeks	56	70	-	-	-	-	44	3.5	-	-
Courtois Creek	55	70	-	-	-	-	45	3.5	-	-
Lost Creek	50	70	-	-	-	-	50	3.5	-	-
Huzzah Creek	55	70	-	-	-	-	45	3.5	-	-
Dry Fork-Spring Creeks	59	70	13	30	-	-	28	3.5	-	1.5
Little Dry Fork Creek	60	70	-	-	-	-	40	3.5	-	-
Benton Creek	49	80	3	30	2	30	46	3.0	-	1.5
BIG RIVER & TRIBUTARY STREAMS										
12	57	80	15	35	6	30	22	3.5	-	1.5
13	57	80	15	35	6	30	22	3.5	-	1.5
14	57	80	15	35	6	30	22	3.5	-	1.5
15	47	70	1	30	-	-	52	3.0	-	1.5
16	47	70	1	30	-	-	52	3.0	-	1.5
17	47	70	1	30	-	-	52	3.0	-	1.5
18	47	70	1	30	-	-	52	3.0	-	1.5
19	47	70	1	30	-	-	52	3.0	-	1.5
20	47	70	1	30	-	-	52	3.0	-	1.5
Terre Bleue Creek	49	70	-	-	-	-	51	3.0	-	-
Dry Creek	49	70	11	35	-	-	40	3.0	-	1.5
Cabanne Course Creek	50	70	-	-	-	-	50	3.0	-	-
Mineral Fork-Bates Creeks	33	70	-	-	-	-	67	3.0	-	-
BOURBEUSE RIVER & TRIBUTARY STREAMS										
21	71	90	12	30	-	-	17	3.0	-	1.5
22	71	90	12	30	-	-	17	3.0	-	1.5
23	61	80	13	30	3	30	23	3.0	-	1.5
24	61	80	13	30	3	30	23	3.0	-	1.5
25	61	80	13	30	3	30	23	3.0	-	1.5
26	61	80	13	30	3	30	23	3.0	-	1.5
27	61	80	13	30	3	30	23	3.0	-	1.5
28	61	80	13	30	3	30	23	3.0	-	1.5
29	61	80	13	30	3	30	23	3.0	-	1.5
30	61	80	13	35	3	30	23	3.0	-	1.5
Spring-Winsel Creeks	86	70	-	-	14	30	-	-	-	-
Boone Creek	78	70	10	35	-	-	12	3.0	-	1.5
Redoak Creek	77	70	-	-	-	-	23	3.0	-	-
Little Bourbeuse River	66	70	-	-	-	-	34	3.0	-	-
Dry Fork-Peavine Creeks	67	70	6	35	-	-	27	3.0	-	1.5
Birch Creek	71	90	12	30	-	-	17	3.0	-	1.5
Brush Creek	61	80	13	35	3	30	23	3.0	-	1.5

* Percent distribution is based on crop acres only. Lespedeza is grown with wheat on the same acreage.

For comparative purposes, data from the Soil Conservation Service on expected average yields in Missouri show that 75 to 90 bushels of corn, 35 to 40 bushels of soybeans, and 3 to 5 tons of hay can be expected from an acre of the Huntington type, Class I, soil which constitutes most of the Meramec River bottom land.

b. Method of determining crop damages. Crop damages have been determined by the procedure developed by the Office, Chief of Engineers, which is outlined in memorandum, ENG CW-E, dated 30 September 1960, subject: "Flood Hydrograph - Damage Integration Method of Estimating Flood Damages in Agricultural Areas". In this method, crop damages are separated into losses of "direct production investments" (DPI) and "loss of income" (LI). DPI values include costs of preparation of ground, seeds, planting, and cultivation and care. These losses vary, depending upon the seasonal occurrence of flood rises and the intervening time from the last preceding flood. LI values include reductions in "net profit" that may result from late planting necessitated by floods where any portion of a crop was not fully harvested. Flood occurrences sometime require excessive delays in the time of crop planting and usually result in below normal yields and profits; other times they occur so late that the crop cannot be replanted, and total loss of expected net income results. These conditions are evaluated in the computation procedure. Based upon cropping practices in the flood plain and estimated average 1962 crop prices, DPI and LI values were determined for each crop, assuming no reduction in expected yields. These are summarized in TABLE Q-4.

TABLE Q-4
DPI and LI values for crop yields - present conditions
(Estimated average 1962 prices)

<u>Crop</u>	<u>Yield</u>	<u>DPI/Ac</u> <u>\$</u>	<u>LI/Ac</u> <u>\$</u>
Corn	70 bu/ac	15.00	41.40
	80 bu/ac	17.80	47.05
	90 bu/ac	22.00	51.30
Wheat	30 bu/ac	16.39	35.66
	35 bu/ac	18.95	42.31
Soybeans	30 bu/ac	16.54	47.51
Hay	2.5 tons/ac	6.42	32.00
	3.0 tons/ac	6.95	39.36
	3.5 tons/ac	7.48	46.72
Lespedeza	1.5 tons/ac	6.75	17.22

Area flooded-percent chance of a flood occurrence curves were developed from area-elevation curves computed for each damage reach from U. S. Geological Survey sheets and from flood frequency profiles furnished in APPENDIX C. Using the above data and the generalized seasonal distribution of the number of flood rises and recessions, average annual crop damage was determined for the cultivated acres shown in TABLE Q-2. This damage totaled \$1,026,500 annually. A breakdown of the damage by reaches is shown in TABLE Q-5.

TABLE Q-5
Average annual crop damage and crop acres flooded - present conditions,
Meramec River Basin

<u>Damage reach</u>	<u>Average annual crop acres</u>	<u>Average annual crop damage \$</u>
MERAMEC RIVER & TRIBUTARY STREAMS		
1	870	\$ 21,400
2	2,490	69,900
3	2,405	72,900
4	475	13,300
5	1,145	32,100
6	975	26,900
7	240	6,900
8	1,085	27,900
9	910	24,900
10	1,255	34,500
11	1,314	34,600
Calvey-Brady Creeks	135	2,400
Indian-Little Indian Creeks	720	24,300
Courtois Creek	650	18,300
Lost Creek	345	10,300
Huzzah Creek	1,040	27,400
Dry Fork-Spring Creeks	2,765	85,500
Little Dry Fork Creek	95	2,400
Benton Creek	31	800
Subtotal	18,945	\$ 536,700
BIG RIVER AND TRIBUTARY STREAMS		
12	2,650	98,800
13	1,250	51,200
14	790	31,800
15	230	6,900
16	330	8,900
17	145	2,700
18	690	19,700
19	175	4,800
20	160	5,000

TABLE Q-5 (Cont'd)

<u>Damage reach</u>	<u>Average annual crop acres</u>	<u>Average annual crop damage \$</u>
Terre Bleue Creek	430	\$ 12,000
Dry Creek	300	9,800
Cabanne Course Creek	10	200
Mineral Fork-Bates Creeks	<u>1,020</u>	<u>30,700</u>
Subtotal	8,180	\$ 282,500
BOURBEUSE RIVER & TRIBUTARY STREAMS		
21	290	8,500
22	935	26,600
23	245	7,100
24	1,500	42,000
25	145	4,200
26	145	3,800
27	345	9,800
28	235	6,700
29	475	13,800
30	930	27,200
Spring-Winsel Creeks	540	10,400
Boone Creek	270	6,100
Redoak Creek	45	900
Little Bourbeuse River	175	3,900
Dry Fork-Peavine Creeks	1,350	34,100
Birch Creek	55	1,600
Brush Creek	<u>20</u>	<u>600</u>
Subtotal	7,700	\$ 207,300
Total	34,825	\$ 1,026,500

13. URBAN AND SCATTERED RESIDENTIAL AND COMMERCIAL DAMAGES

Initial surveys established the start of the damage elevation for each industry, commercial establishment, and residence. Owners of industries and commercial establishments were then interviewed to obtain indications of the probable flood damages to their buildings and grounds, equipment, inventory, loss of non-recoverable business, loss of wages to employees, together with increased expenditures for operation during flood periods, flood fight, and cleanup. In addition to the start of damage elevation, the estimated value of each residence was obtained. Damage elevation-frequency relationships were developed for each industrial, commercial, and residential property. Previously established depth of flooding versus value of residence relationships were used to evaluate damages to homes and contents. A summary of properties subject to damage is outlined in paragraph 5 of this appendix. The town of Valley Park has experienced significant flood damages about every 5 years. It is estimated that average annual residential,

industrial, and commercial damages to this town amount to \$45,600, \$113,800, and \$11,500, respectively, totaling \$171,900. Development in Fenton is flooded approximately every 3 years. Total average annual damage was estimated to be \$38,600. Times Beach, like Fenton, is primarily residential and some of its property is flooded approximately every 3 years. Estimated average annual damage is \$41,000. Property in Glencoe is damaged about every other year. Its average annual damage is estimated to be \$5,000. Damage in Pacific begins at approximately a 10-year frequency flood. Average annual estimated damage is \$18,600. Damage at Cedar Hill starts with a 10-year frequency flood. Its estimated average annual damage is \$1,000. Total average annual urban and scattered residential and commercial damages, estimated at \$430,700, are summarized in TABLE Q-6 for each damage reach.

TABLE Q-6
Average annual urban and scattered residential and commercial damages -
present conditions

Damage reach	Average annual damages			
	Residential \$	Commercial \$	Industrial \$	Total \$
MERAMEC R. & TRIB. STREAMS				
1	58,900	28,300	0	87,200
2	89,600	25,300	114,900	229,800
3	8,600	0	0	8,600
7	0	37,100	0	37,100
8	0	26,400	0	26,400
10	0	1,500	0	1,500
Fenton Creek	1,300	37,300	0	38,600
Subtotal	158,400	155,900	114,900	429,200
BIG R. & TRIB. STREAMS				
12	800	200	0	1,000
Subtotal	800	200	0	1,000
BOURBEUSE R. & TRIB. STREAMS				
22	0	500	0	500
Subtotal	0	500	0	500
Total	159,200	156,600	114,900	430,700

Estimates of damage in excess of those given above and those for reaches 7 and 8 are to scattered residences and commercial establishments. The \$37,100 annual benefit for damage reach 7 is to Meramec Caverns and the \$26,400 annual damage in reach 8 is to Meramec State Park. While there is some damage from high floods to picnicking facilities at Onondaga Cave and Washington State Park, these damages are insignificant on an average annual basis.

14. RURAL NON-AGRICULTURAL DAMAGES

Farm sets located within the flood plain generally experience start of damage at about a 20-year frequency flood. The value of and damage to these farm sets were established in the field damage survey; it is estimated that the average annual damage per farm set is about \$160. Average annual damages to farm sets derived from this estimate, together with the number of these units obtained from county maps published by the Missouri State Highway Department and the U. S. Bureau of Public Roads, total \$71,000. A breakdown of these damages by reaches is shown in TABLE Q-7.

15. CLUBHOUSES

The dwelling portions of the 2,100 recreational housing units, or clubhouses, are constructed approximately 7 to 8 feet above ground level. Discussions with clubhouse owners indicate that they experience flooding inside the clubhouses approximately every 7 to 10 years. After flooding has not been experienced for a few years, owners tend to develop the portion underneath the dwelling units for storage or as additions to their living quarters. It is estimated that the average annual damage per clubhouse amounts to approximately \$25. Use of this value and the number of clubhouses in each damage reach as obtained from county highway maps indicate that the total average annual damage to these units amounts to \$59,100. A breakdown of this damage estimated by reach is shown in TABLE Q-7.

16. FENCE DAMAGE

Since agriculture in the basin is based upon a livestock economy, the amount of fencing used is substantial. Annual repairs to fencing is common practice since even minor overbank flooding will usually deposit debris along the fence lines. This debris is conducive to corrosion of the fence or destruction of its strength if not cleaned off. Creek fence crossings are sometimes destroyed by within bank flows. Major floods have approached total destruction of fencing on individual farms. Many farmers claim that fence damage is ordinarily a substantial portion of their total flood damage. It is estimated that fence damage amounts to \$4.00 per crop acre. When applied to the average annual number of crop acres flooded in each reach, total average annual fence damage is estimated to be \$139,300. Damage by reaches is shown in TABLE Q-7.

17. EQUIPMENT, LIVESTOCK, AND EROSION DAMAGES

Damages to farm equipment, loss of livestock, and the cost of repair of farm ditches and dikes total \$27,800 annually. A breakdown of these damages by reaches is shown in TABLE Q-7.

18. ROADS

County highway engineers were interviewed to determine the extent of road damage due to floods. Depending upon the severity of the flood, damages to roads range from cleanup problems to complete replacement of sections of sub-grade and surface. The degree of monetary damage varies considerably with the type of road damaged. Those in the flood plain downstream from Pacific are generally a better quality than those along the Big and Bourbeuse Rivers and the upper reaches of the Meramec River. Also the quality of the roads along the tributary creeks decreases as compared with those along the main stems. Estimated damages per flood are \$450 per mile of inundated road in the Meramec River flood plain downstream from Pacific, \$250 per mile for roads upstream from Pacific on the Meramec and along the Big and Bourbeuse Rivers, and \$150 per mile for roads along the tributary creeks. The lengths of roads in the flood plain between the various elevations were determined from county highway maps and U. S. Geological sheets. Through coordination of these data with the aforementioned elevation-flood frequency profiles, average annual miles of roads flooded in the various reaches were developed. The product of average annual miles of roads flooded and damage per mile resulted in the damage values shown in TABLE Q-7 which totals \$80,900 for the basin.

19. RAILROAD DAMAGE

Based on reported damages experienced in the past by railroad companies having track in the Meramec River flood plain, together with railroad bed profiles obtained from these companies, the average annual damage to railroads was estimated to be \$51,700 in all reaches. Damage by reach is shown in TABLE Q-7.

20. BRIDGE DAMAGE

Most bridge damage occurs to deck type bridges or to paved fords maintained by the county highway departments. The latter type consists of slabs of concrete laid in the bed of the stream. Bridges constructed and maintained by the State Highway Department are of higher quality construction and generally withstand damage from even severe floods. Estimated average annual bridge damage totaling \$15,500 is shown by reaches in TABLE Q-7.

21. TOTAL AVERAGE ANNUAL DAMAGES - PRESENT CONDITIONS

Summary average annual damages for present conditions is \$1,902,500. Of this amount, \$16,500 damage to crops and \$88,800 damage to property in damage reaches 1 and 2 are due to Mississippi River backwater.

TABLE Q-7
Average annual damages - present conditions, Meramec River Basin

Damage reach	Agricultural	Urban	Farm sets	Club houses	Roads	Rail-roads	Bridges	Fences	Equip. & Livestock	Erosion	Total
\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
MERAMEC RIVER & TRIBUTARY STREAMS											
1	21,400	87,200	1,400	8,300	7,400	13,200	0	3,500	400	400	143,200*
2	69,900	229,800	1,700	19,500	19,000	26,100	600	10,000	1,400	1,400	379,400*
3	72,900	8,600	600	2,700	4,100	5,500	0	9,900	1,100	1,100	106,200
4	13,300	0	600	300	300	0	0	1,900	300	300	17,000
5	32,100	0	500	2,200	1,200	1,900	300	4,600	500	500	43,800
6	26,900	0	300	700	1,000	0	0	3,900	400	400	33,600
7	6,900	37,100	500	100	700	0	0	1,000	100	100	46,500
8	27,900	26,400	1,600	1,000	3,400	0	400	4,200	400	400	65,800
9	24,900	0	500	200	1,200	0	300	3,600	300	300	30,300
10	34,500	1,500	300	1,400	1,100	0	100	5,000	400	400	44,900
11	34,600	0	3,400	0	5,300	0	100	5,300	600	600	49,900
Fenton Creek	0	38,600	0	0	0	0	0	0	0	0	38,600
Benton Creek	800	0	100	0	100	0	0	100	0	0	1,100
Calvey-Brady Creeks	2,400	0	1,800	0	800	0	900	500	0	200	6,600
Indian-Little Indian Creeks	24,300	0	4,500	300	1,600	0	100	2,900	0	300	34,000
Courtois Creek	18,300	0	2,700	200	1,000	0	500	2,600	0	400	26,700
Lost Creek	10,300	0	3,700	200	1,100	0	0	1,300	0	200	16,800
Hozziah Creek	27,400	0	7,800	600	1,400	0	1,000	4,200	0	900	43,300
Dry Fork-Spring Creeks	85,500	0	3,200	0	1,300	0	1,100	11,000	0	1,500	103,600
Little Dry Fork Creek	2,400	0	0	0	100	0	0	400	0	100	3,000
Subtotal	536,700	429,200	36,400	37,700	51,100	46,700	5,400	75,700	5,900	9,500	1,234,300
BIG RIVER & TRIBUTARY STREAMS											
12	98,800	1,000	3,100	11,800	6,000	0	600	10,600	1,600	1,200	134,700
13	51,200	0	200	3,900	1,500	0	600	5,000	500	400	63,300
14	31,800	0	800	400	0	0	300	3,200	400	300	37,200
15	6,900	0	800	0	0	0	300	900	100	100	9,100
16	8,900	0	500	400	700	0	600	1,300	200	200	12,800
17	2,700	0	300	0	1,400	900	0	600	100	100	6,100
18	19,700	0	0	0	4,700	800	300	2,800	500	600	29,200
19	4,800	0	1,000	600	2,000	0	0	700	100	100	8,700
20	5,000	0	2,400	0	3,000	0	0	600	100	0	11,100
Terre Bleue Creek	12,000	0	2,400	100	300	0	1,000	1,700	200	200	17,900
Dry Creek	9,800	0	2,700	0	800	0	1,000	1,200	100	100	15,700
Cabanne Course Creek	200	0	200	0	0	0	0	0	0	0	400
Mineral Fork-Bates Creeks	30,700	0	8,200	400	1,100	0	1,500	4,100	600	500	47,100
Subtotal	282,500	1,000	22,600	17,000	21,500	1,700	6,200	32,700	4,500	3,600	393,300
BOURBEUSE RIVER & TRIBUTARY STREAMS											
21	8,500	0	200	300	600	0	0	1,200	0	100	10,900
22	26,600	500	900	3,000	800	3,100	300	3,800	200	500	39,700
23	7,100	0	200	300	200	0	0	1,000	0	100	8,900
24	42,000	0	0	600	600	0	0	6,000	200	600	50,000
25	4,200	0	200	0	0	0	0	600	0	100	5,100
26	3,800	0	0	0	200	0	0	600	0	100	4,700
27	9,800	0	300	0	700	0	0	1,300	0	200	12,300
28	6,700	0	300	0	200	0	0	900	0	100	8,200
29	13,800	0	200	0	300	0	0	1,900	100	200	16,500
30	27,200	0	2,100	0	1,400	0	700	3,700	100	400	35,600
Spring-Minsel Creeks	10,400	0	600	0	500	0	0	2,200	0	200	13,900
Boone Creek	6,100	0	2,100	0	400	0	1,000	1,100	0	200	10,900
Redoak Creek	900	0	300	0	400	0	600	200	0	100	2,500
Little Bourbeuse River	3,900	0	800	0	200	0	600	700	0	100	6,300
Dry Fork-Pearline Creeks	34,100	0	3,700	0	1,800	0	700	5,400	0	700	46,400
Birch Creek	1,600	0	100	200	0	200	0	200	0	0	2,300
Brush Creek	600	0	0	0	0	0	0	100	0	0	700
Subtotal	207,300	500	12,000	4,400	8,300	3,300	3,900	30,900	600	3,700	274,900
Total	1,026,500	430,700	71,000	59,100	80,900	51,700	15,500	139,300	11,000	16,800	1,902,500

* Approximately 10,500 acres are subject to flooding by backwater from high Mississippi River stages. Damages chargeable to Mississippi River backwater amount to \$16,500 to crops and \$88,800 to property.

SECTION IV - AGRICULTURAL DEVELOPMENT - FUTURE CONDITIONS WITHOUT IMPROVEMENT

22. GENERAL

Developed land in Meramec River bottoms is used primarily for agricultural pursuits. Consideration of potential development in the bottoms without flood control improvements indicates that there will be no significant change in this use. It is considered that farming practices will continue to be based on a livestock economy. Also, it is anticipated that there will be continued marked increases in production per bottom land acres as in other areas of the nation. In its brochure "Land and Water Resources, A Policy Guide" dated September 1962, the U. S. Department of Agriculture estimates that the United States crop and pasture production per acre in 1980 will be 56 and 35 percent greater, respectively, than 1959 productions. These estimates are based on projections of trends in yields in the past decade. Yields have also been used herein as the most rational measure of production.

23. PAST CROP YIELD TRENDS

A tabulation of annual yields for the United States, Missouri, and Meramec Basin counties for the period 1950 through 1961 for corn, wheat, soybeans, and hay is shown in TABLE Q-8.

TABLE Q-8
Average yields - United States, Missouri, and eight Meramec Basin counties

Year	Corn (bu/ac)			Wheat (bu/ac)			Soybeans (bu/ac)			All hay (tons/ac)		
	U.S.	Mo.	Mer. Basin	U.S.	Mo.	Mer. Basin	U.S.	Mo.	Mer. Basin	U.S.	Mo.	Mer. Basin
1950	38.2	44.0	37.7	16.5	17.5	15.0	14.6	23.0	16.1	1.38	1.27	1.23
1951	36.9	34.0	37.2	16.0	17.0	18.6	15.2	20.0	16.0	1.46	1.28	1.46
1952	41.8	41.0	36.9	18.4	22.0	21.3	15.3	18.5	17.7	1.42	1.06	1.05
1953	40.7	33.5	31.5	17.3	26.0	25.8	16.2	13.5	14.1	1.44	.98	.96
1954	39.4	20.0	14.1	18.1	30.0	27.0	16.1	14.5	8.4	1.46	1.26	1.24
1955	42.0	40.0	40.0	19.8	31.0	29.3	16.5	17.5	17.7	1.50	1.46	1.67
1956	47.4	48.0	47.9	20.2	30.5	31.3	16.6	20.0	18.1	1.49	1.31	1.57
1957	48.3	44.0	44.8	21.8	23.0	18.1	17.7	21.5	18.9	1.67	1.49	1.61
1958	52.8	54.0	52.2	27.5	28.0	26.0	17.0	26.0	26.1	1.70	1.65	1.53
1959	53.1	53.0	44.9	21.7	25.0	24.4	18.8	22.0	20.9	1.67	1.56	1.45
1960	54.5	52.0	38.9	26.2	28.5	30.4	17.2	21.5	18.5	1.76	1.57	1.63
1961	61.8	62.0	57.3	23.9	30.5	29.0	16.5	24.5	21.6	1.74	1.70	1.80

Source of data - Monthly Crop Production bulletins published by the U. S. Department of Agriculture and Missouri Annual Crop and Livestock production bulletins published by the Missouri State Department of Agriculture.

The basin counties for which data are included are Washington, Crawford, St. Louis, Jefferson, Franklin, Gasconade, St. Francois, and Phelps. Data have not been included for Dent, Maries, and Iron Counties because bottom land acreages in these counties are, with minor exceptions, located upstream from the uppermost considered reservoir. Meramec bottom acreages constitute about 17 percent of the total crop acreages in those counties. The data indicate that the basin county yields are, in general, not as good as the State average but that the State yields are about on par with the national average. All crops have shown a consistent growth in yield values. Plots of the average crop yields in the eight Meramec Basin counties for the period 1920 through 1961 are shown on PLATES Q-2 through Q-5, inclusive. The graphs show that a marked increase occurred since 1950 when, according to the Department of Agriculture's publication, "Food and Agriculture, A Program for the 1960's" dated March 1962, "greater use of fertilizer, better plant varieties, more and better chemicals and machinery, and more skillful farming combined to push 1961 crop yields 40 percent above 1950 levels." This was accomplished "despite declining prices and incomes, efforts to restrict production through allotments on cotton, wheat, and other crops, the Soil Bank, and other programs." One method which was considered for projecting crop yields was an extrapolation of the trends of the past 10 years. However, it was believed that the rate of increase during these years would not be sustained over a long period of time. A more conservative method would be to base the projection on the trends of the past 20 years. Straight line extrapolations of this period were used and are shown on PLATES Q-2 through Q-5. Resulting increases over 1962 average yields derived from these curves are shown in TABLE Q-9.

TABLE Q-9
Percent increase in average yields - eight Meramec Basin counties

<u>Crop</u>	<u>Percent increase in yields</u>			
	<u>1962</u>	<u>1970</u>	<u>2020</u>	<u>2070</u>
Corn	0	14.2	108.0	205.0
Wheat	0	19.9	144.4	269.0
Soybeans	0	19.9	144.4	269.0
Hay	0	10.0	72.5	135.0

24. FACTORS INFLUENCING FUTURE TRENDS

In order to obtain an indication of crop yields to be expected in the future, contacts were made with professors at the University of Missouri, agricultural extension agents, seed and chemical researchers, and other individuals with possible knowledge of future agricultural trends. The following is the consensus of opinion of the people interviewed pertaining to the different crops grown in the basin and factors affecting the trends.

a. Corn. An average corn yield of 175 bushels per acre is foreseeable on good land within the next 50 years. This will be due to substantial improvement in the genetic field of corn in which future hybrids will be made more adaptable to soil types with changed characteristics such as more ears per stalk and more plants per acre, greater knowledge of the nutrient balance required by crops for optimum yields, improved cultural practices, particularly the use of pesticides and weed killers, improved machinery and equipment, and improved uses of fertilizers, especially nitrogen. Perhaps the greatest single factor for increasing corn yields in the future will be the continuous planting of corn. Practice has shown that 3 to 4 years of continuous corn growth has increased corn yields 25 to 30 percent.

b. Wheat. Hybrid wheat seed will soon be produced on a commercial basis, and immediate boosts in wheat yields due to this factor should approximate 30 percent. Within the next 50 years, average wheat yields of approximately 65 bushels per acre should be obtained.

c. Soybeans. Increases in average soybean yields to about 60 bushels per acre are anticipated.

d. Hay. The major increase in all anticipated yields is in hay. Estimates are that they will increase many times their present values on bottom land fields. The main factor in this change will be a switch from a pasture-type grass to the more prolific sudan-type grasses and those of the sorgo family. Yields are estimated at 10 to 12 tons.

e. Production practices. Mechanization will continue to play an important role in increased agricultural production. Improved equipment will increase yields by giving faster production in the critical phases of planting and harvesting. Machinery presently in production includes rakes for combination raking and tedding of grass or legume hay, wafering machines which compress hay into wafers for cattle feed, one-man balers, silage shredders, larger combines, grain and hay loading units, and corn pickers.

f. Production costs. Present high-priced farm labor is rapidly being replaced by new-type farm machinery, which should result in reduced production costs. The trend on most farms in the basin is for one-man operation; many of the new equipment designs are based upon single-man operations.

25. PROJECTION OF FUTURE CROP YIELDS

Future yield trend curves were developed for the Meramec River Basin flood plain as follows:

a. Basic 1961 bottom land yields were adjusted downward to average conditions as discussed in paragraph 12a of this appendix. Using percentage increases in yields developed from the eight-county yield trend curves for each crop, initial bottom land yield growths to year 2020 were defined in curve form.

b. In the interviews described in the preceding paragraphs, questions regarding potential yields were restricted to those obtainable during the coming 50 years. Interview results given in the paragraph indicate that the projected Meramec River bottoms yields for year 2020 are reasonably attainable.

c. For conservatism, the estimated bottom land yields for year 2020 were considered as obtainable only at the end of the considered 100-year period - year 2070.

d. The interim period growth trends between about year 2000 and 2070 were defined by a curve asymptotic to the initial growth curve described in subparagraph a above and the yield for year 2070 defined in subparagraph c above.

e. PLATE Q-6 shows crop yield growth trend curves of each type crop in the Meramec Basin for future conditions without improvement.

26. DISCOUNTED AVERAGE ANNUAL YIELDS

It can be visualized that crop damages corresponding to the future yields shown on the growth curves on PLATE Q-6 would vary from year to year depending on the magnitude of the yields. Since damages computed for each year would need to be discounted to obtain average annual damages, consideration was given to obtaining average annual yields using discounting procedures and computing average annual damages therefrom. A test computation was made for estimated damage to corn acreage in one reach by simulating the yield trend curve with straight lines between the years 1970 and 1995, 1995 and 2020, 2020 and 2050, and 2050 and 2070. Damages were then computed at the breakpoints and discounted. A comparative computation was made in which each annual yield in the trend

curve was discounted and damage computations were made, based on the average annual discounted yields. The difference in the results of the two computations was not significant and could be attributed to approximations made. The procedure for determining damages based on the use of average annual discounted yields was thus adopted.

27. AVERAGE ANNUAL YIELDS - FUTURE CONDITIONS WITHOUT IMPROVEMENT

Average annual discounted yields for the 100-year period, 1970 to 2070, rounded to the closest five bushels or half ton, are shown in TABLE Q-10, together with present yields.

TABLE Q-10

Present and average annual yields per acre - Meramec Basin flood plain

<u>Crop</u>	<u>Present condition w/o improvement</u>	<u>Future condition w/o improvement</u>
Corn	70 bu.	115
	80 bu.	130
	90 bu.	145
Wheat	30 bu.	50
	35 bu.	65
Soybeans	30 bu.	50
Hay	2.5 ton	3.5
	3.0 ton	4.0
	3.5 ton	5.0
Lespedeza	1.5 ton	2.0 ton

The present-future yield relationship affords a means of designating future yields without improvement for each reach corresponding to the present yields shown in TABLE Q-3. Since present yields are based partly on the inherent productivity of soils and partly on the cropping practices of individual farmers, there is a range of yield values throughout the basin. Although farmers will continue to improve their practices in the future, there will still remain a difference in soil productivity and cropping methods. However, available data on growth capabilities do not provide adequate information to provide a measure of the differences. For this reason, the same rate of growth was used for all yields of a particular crop. In addition, since crop yields will increase primarily because of improvements in the genetic field, greater knowledge of the nutrient balance required by crops for optimum yields, and improved machinery and equipment rather than improved uses of fertilizers, pesticides, and weed killer, an ultimate yield limit cannot be estimated at this time. According to the U. S. Department of

Agriculture publication, "Food and Agriculture", "despite great gains, we are yet in the foothills of technical progress in agriculture - not at the peak. Unless all signs fail, the ceiling on crop yields is still far in the future."

28. IRRIGATION

At the present time, there is little irrigation of crops in the Meramec River bottoms. Except for approximately 200 acres in truck farming in the bottoms near the mouth of the Meramec River, irrigation is known to be used on only a few farms in the upper reaches of the river. Since the basin is located in a semi-humid climate where annual rainfall amounts are generally adequate for crop production, little use of irrigation is indicated for the future. The basin, located in the Ozark Mountains, has a high ground water level ideally suited for well supply. Furthermore, the present and anticipated woodland coverage of the rural portion of the basin will be conducive to maintaining this high ground water level. In the event that modifications in future cropping practices require a more stabilized water supply to maximize yields, it is anticipated that such supply will be obtained from wells rather than from large distribution systems using river water.

SECTION V - URBAN DEVELOPMENT, FUTURE CONDITIONS WITHOUT IMPROVEMENT

29. GENERAL

There is little property development subject to flood damage upstream from Pacific. No basis has been found for considering that this condition will change. There have been some recent subdivision developments in the flood plain downstream from Pacific in Jefferson County. Without zoning regulations, it is anticipated that there will be an increase in this type of construction. However, planning now underway should result in some type of restrictive legislation on development.

30. FLOOD PLAIN ZONING

The St. Louis County Planning Commission has prepared a comprehensive land use plan for the county in which certain areas considered unsuitable for urban development, historic sites and buildings, scenic vistas, recreational areas, and the flood plains of water bodies within and adjacent to the county are to be reserved for open space use. Because of the scenic beauty of Meramec River and because of its recreational potential, the area in and adjacent to the flood plain delineated for open space use has been designated a "green belt". Recommended zoning regulations would preclude any use of the flood plain for other than agricultural and recreational purposes. A planning commission has recently been established in Jefferson County. While there has not been time for this organization to develop plans, it is anticipated that recommendations similar to those made by the St. Louis County Planning Commission will be prepared. It is considered that zoning regulations will likely be enacted before a significant amount of additional development is constructed in the flood plains. It is known that in anticipation of these regulations, some development, particularly industrial, in the flood plains has been discouraged.

SECTION VI - FLOOD DAMAGES, FUTURE CONDITIONS WITHOUT IMPROVEMENT

31. GENERAL

The details of flood damages under future conditions without improvement are summarized in the following paragraphs. Since these damages have been prepared for the purpose of determining the feasibility of reservoirs, damages have not been determined for those areas subject to inundation by the reservoir.

32. AGRICULTURAL DAMAGE

DPI and LI values corresponding to the average annual yield under future conditions without improvement are given in TABLE Q-11.

TABLE Q-11
DPI and LI values for yields - future conditions without improvement
(Estimated average 1962 prices)

<u>Crop</u>	<u>Yield/Ac</u>	<u>Future Conditions w/o improvement</u>	
		<u>DPI/Ac</u>	<u>LI/Ac</u>
		<u>\$</u>	<u>\$</u>
Corn	115 bu	32.10	62.25
	130 bu	38.70	68.20
	145 bu	45.30	74.15
Wheat	50 bu	29.63	59.22
	65 bu	36.31	80.24
Soybeans	50 bu	20.55	88.33
Hay	3.5 tons (1)	6.75	47.72
	4.0 tons (2)	7.36	59.77
	5.0 tons (3)	7.97	71.82
Lespedeza	2.0 tons	6.75	25.66

- (1) Grass hay
- (2) Combination hay
- (3) Alfalfa hay

Using these values and the percent cropland distribution shown in TABLE Q-3, average annual crop damages for future conditions without improvement were derived by the procedure outlined in paragraph 12b. Average annual crop damages for this condition are estimated to be \$1,341,300 annually. Damages by reach are shown in TABLE Q-12.

TABLE Q-12
Average annual damages - future conditions without improvement
Meramec River Basin

Damage reach	Agric. \$	Urban \$	Farm sets \$	Clubhouses \$	Roads \$	Railroads \$	Bridges \$	Fences \$	Equip. & Livestock \$	Erosion \$	Total \$
MERAMEC RIVER & TRIB. STREAMS											
1	38,200	87,200	1,400	8,300	7,400	13,200	0	3,500	400	400	160,000*
2	125,300	229,800	1,700	19,500	19,000	26,100	600	10,000	1,400	1,400	434,800*
3	121,400	8,600	600	2,700	4,100	5,500	0	9,600	1,100	1,100	164,700
4	23,000	0	600	300	300	0	0	1,900	300	300	26,700
5	58,000	0	500	2,200	1,200	1,900	300	4,600	500	500	69,700
7	0	37,100	0	0	0	0	0	0	0	0	37,100
10	57,600	1,500	500	1,400	1,100	0	100	5,000	400	400	68,000
11	56,200	38,600	3,400	0	5,300	0	100	5,300	600	600	71,500
Fenton Creek	0	0	0	0	0	0	0	0	0	0	38,600
Benton Creek	1,300	0	100	0	100	0	0	100	0	0	1,600
Calvey-Brady Creeks	4,400	0	1,800	0	800	0	900	500	0	200	8,600
Indian-Little Indian Creeks	15,200	0	0	300	1,100	0	0	1,100	0	100	17,800
Courtois Creek	17,800	0	1,600	200	800	0	400	1,600	0	200	22,600
Lost Creek	16,900	0	3,700	200	1,100	0	0	1,300	0	200	23,400
Huzzah Creek	19,600	0	4,000	600	1,100	0	600	1,900	0	400	28,200
Dry Fork-Spring Creeks	144,500	0	3,200	0	1,300	0	1,100	11,000	0	1,500	162,600
Little Dry Fork Creek	3,900	0	0	0	100	0	0	11,400	0	100	4,500
Subtotal	713,300	402,800	23,100	35,700	44,800	46,700	4,100	57,800	4,700	7,400	1,340,400
BIG RIVER & TRIB. STREAMS											
12	180,400	1,000	3,100	11,800	6,000	0	600	10,600	1,600	1,200	216,300
13	91,800	0	200	3,900	1,500	0	600	5,000	500	400	103,900
17	4,200	0	300	0	1,400	900	0	600	100	100	7,600
18	23,200	0	0	0	4,700	800	300	2,300	500	400	32,200
20	8,300	0	2,400	0	3,000	0	0	600	100	0	14,400
Terre Bleue Creek	19,800	0	2,400	100	300	0	1,000	1,700	200	200	25,700
Dry Creek	16,700	0	2,700	0	800	0	1,000	1,200	100	100	22,600
Cabanne Course Creek	300	0	200	0	0	0	0	0	0	0	500
Mineral Fork-Bates Creeks	8,400	0	3,800	400	300	0	600	700	100	100	14,400
Subtotal	353,100	1,000	15,100	16,200	18,000	1,700	4,100	22,700	3,200	2,500	437,600
BOURBEUSE RIVER & TRIB. STREAMS											
21	15,500	0	200	300	600	0	0	1,200	0	100	17,900
22	48,900	500	900	3,000	800	3,100	300	3,800	200	500	62,000
26	6,800	0	0	0	200	0	0	600	0	100	7,700
27	17,400	0	300	0	700	0	0	1,300	0	200	19,900
28	13,000	0	300	0	200	0	0	900	0	100	14,500
29	25,700	0	200	0	300	0	0	1,900	100	200	28,400
30	49,500	0	2,100	0	1,400	0	700	3,700	100	400	57,900
Spring-Winsel Creeks	12,000	0	200	0	0	0	0	1,200	0	100	13,500
Boone Creek	11,600	0	2,100	0	400	0	1,000	1,100	0	200	16,400
Redoak Creek	1,700	0	300	0	400	0	600	200	0	100	3,300
Little Bourbeuse River	7,000	0	800	0	200	0	600	700	0	100	9,400
Dry Fork-Peavine Creeks	61,800	0	3,700	0	1,800	0	700	5,400	0	700	74,100
Birch Creek	2,900	0	100	200	0	200	0	100	0	0	3,600
Brush Creek	1,100	0	0	0	0	0	0	100	0	0	1,200
Subtotal	274,900	500	11,200	3,500	7,000	3,300	3,900	22,300	400	2,800	329,800
Total	1,341,300	404,300	49,400	55,400	69,800	51,700	12,100	102,800	8,300	12,700	2,107,800

* Approximately 10,500 acres are subject to flooding by backwater from high Mississippi River stages. Damages chargeable to Mississippi River backwater amount to \$29,400 to crops and \$88,800 to property.

Note: Values shown differ from those indicated in TABLE 15 of the main report due to omission of reaches within reservoir areas.

33. NON-CROP DAMAGES

As discussed in Section III of this appendix, major urban damage occurs in the lower reaches of the Meramec River. It is considered that St. Louis and Jefferson Counties will enact zoning regulations for the flood plain before significant additional development is constructed. Such zoning would limit property subject to flood damage to its present level. As a result, average annual damages have been assumed to be the same as those under present conditions exclusive of the areas to be inundated by reservoirs. Average annual urban damages under future conditions without improvement total \$404,300. Other types of non-crop damage total \$362,200 annually. Damages by reach are shown in TABLE Q-12.

34. TOTAL AVERAGE ANNUAL FLOOD DAMAGE, FUTURE CONDITIONS WITHOUT IMPROVEMENT

Average annual flood damage in the basin under future conditions without improvement totals \$2,107,800

SECTION VII - AGRICULTURAL DEVELOPMENT, FUTURE CONDITIONS WITH IMPROVEMENT

35. GENERAL

The construction of flood protection works will alleviate flooding to variable degrees in the flood plains downstream from the reservoirs. In some reaches, the reservoirs will confine the flows to within banks. One of the reaches where damaging floods will be substantially reduced is in the vicinity of Valley Park. A high degree of flow reductions will be affected downstream from Valley Park to the limits of Mississippi River backwater. Expanding urbanization of metropolitan St. Louis will spread to the river flood plain in these reaches in the not too distant future. It is visualized that when this occurs, there will be a demand in some of the flood plain areas for a higher degree of land use. Should those areas have been zoned to open space use by that time, it is considered that rezoning will be a likelihood because the prime purpose for the zoning, namely flood damage, will have been alleviated. The flood plains throughout the Meramec River basin are expected to remain in agricultural use in the future, except for certain of those areas within the urbanized portion of metropolitan St. Louis. Specific locations of those areas are treated in later sections of this appendix.

36. AVERAGE ANNUAL YIELDS, FUTURE CONDITIONS WITH IMPROVEMENTS

Comparative analysis of crop yields obtained on lands subject to frequent flooding and on lands that are relatively flood free, together with the consideration that more intensive cropping procedures will be practiced if the degree of present flooding is substantially reduced, indicates that crop yields will become higher when flood control works are constructed. It is estimated that corn yields will be about 30 percent higher and hay yields about 20 percent higher. No significant change is indicated for wheat or soybean yields. Average annual discounted yields for future conditions with improvement were developed in the same manner as those for future conditions without improvement taking into consideration these estimated increases. The trend curves are shown on PLATE Q-7. Comparative average annual yields for conditions with and without improvement are shown in TABLE Q-13.

TABLE Q-13
Average annual yields per acre -
future conditions with and without improvement

<u>Crop</u>	<u>Future conditions without improvement</u>	<u>Future conditions with improvement</u>
Corn	115 bu.	150 bu.
	130 bu.	170 bu.
	145 bu.	190 bu.

TABLE Q-13 (Cont'd)

<u>Crop</u>	<u>Future conditions without improvement</u>	<u>Future conditions with improvement</u>
Wheat	50 bu. 65 bu.	50 bu. 65 bu.
Soybeans	50 bu.	50 bu.
Hay	3.5 ton 4.0 ton 5.0 ton	4.5 ton 5.0 ton 6.0 ton
Lespedeza	2.0 ton	2.5 ton

Discussions with farmers, county extension agents, and representatives of the Soil Conservation Service indicate that the soils in the bottoms should be capable of producing these yields. It is expected that the agricultural economy of the basin will continue to be based on livestock production if flood control improvements are provided with the result that corn and hay will be the principal crops grown.

37. CONVERTED LAND USE

Some of the bottom land most subject to frequent flooding is in timber. Discussions with the farmers during the field surveys have shown their desire to expand their flood plain crop acreages into these timber areas if the depth and frequency of flooding are diminished. Based upon their views, it is estimated that approximately 10 percent of the timber acreage will be converted to cropland.

SECTION VIII - URBAN DEVELOPMENT, FUTURE CONDITIONS WITH IMPROVEMENT

38. GENERAL

The areal spread of urbanization from St. Louis during the past decade has been phenomenal. While the most dramatic construction has been to the north and west of St. Louis due to the completion of superhighways in those directions, residential and commercial growth to the south and southwest toward Meramec River has also been substantial. Some of this growth has extended south of Meramec River into Jefferson County where new residential construction is estimated at 1,500 homes annually. Also, there has been a recent movement toward additional industrialization along Meramec River. One industry, the Chrysler Assembly Plant, located on the river near Valley Park, started operation in 1959 and employs 2,600 persons. Several other plants are now under construction in the vicinity. Industrial park operators, one of which is a railroad company, are promoting the area.

39. RATE OF URBANIZATION ALONG MERAMEC RIVER

The lower Meramec River downstream from Valley Park is located between 15 and 18 miles from the center of downtown St. Louis. Presently about two-thirds of the intervening area is urbanized. Interstate Highways 44 to the southwest from St. Louis and 55 to the south are presently under construction. These, together with a circumferential highway around St. Louis, will provide short time-distance access to the yet undeveloped areas along lower Meramec River. Based upon the increase in development experienced as a result of highway construction north and west of St. Louis, it is anticipated that growth in development toward Meramec River will mushroom in the immediate future. A detailed analysis of population growths in St. Louis County was made by the University of Chicago for the county in 1962 for the purpose of establishing potential school district requirements. This study indicated that the Meramec River area between Fenton and Valley Park will be urbanized between 1980 and 1990, downstream from Fenton to the mouth of the river between 2000 and 2010, and upstream from Valley Park to Pacific after 2010. These estimates are considered to be realistic.

40. REFERENCE STUDIES

Many comprehensive studies have been made which form background detail for these analyses. The most pertinent of these studies are reported in the following:

a. "Path of Progress Report for Metropolitan St. Louis", dated 1957. This report is considered as being the most comprehensive metropolitan area survey of its type ever undertaken in the United States. The study, made by St. Louis and Washington Universities, was for the purpose of recommending changes in the St. Louis-St. Louis County governmental complex which would best contribute to the growth of the St. Louis metropolitan area.

b. "Changing Industrial Patterns in Metropolitan St. Louis and the Demand and Supply of Industrial Land to 1980", dated December 1961. This report is an annex to APPENDIX B.

c. "Report on Population, Land Use and Employment, St. Louis Metropolitan Area", dated 1957. This report was prepared by Dr. Ernest Jurkat, Marketers Research Services, Incorporated, for W. C. Gilman and Company, 1959 report, "St. Louis Metropolitan Area Transportation Study, 1957 - '70 - '80". This latter report was incorporated in the "Highway Planning Study for the St. Louis Metropolitan Area" prepared by Wilbur Smith and Associates for the Missouri State Highway Commission and the U S. Department of Commerce, Bureau of Public Roads, and provides the basis for future mass highway transportation in the area.

d. "School District Organization in St. Louis County, Missouri", dated June 1962. The report, made by Education Field Services, Graduate School of Education, University of Chicago, summarizes the probable needs for educational facilities and services to 1970 in each St. Louis County township.

e. "Guide for Growth", dated 1962. This report presents the St. Louis County Planning Commission's proposed land use plan for St. Louis County.

41. FACTORS INFLUENCING FUTURE GROWTH OF THE ST. LOUIS METROPOLITAN AREA

a. General. Metropolitan St. Louis, the ninth most populous metropolitan area in the nation, is a major manufacturing and distribution center. It is the nation's second largest rail center, its second largest trucking center, and has one of the country's busiest inland waterway ports. Its wide diversification of industry gives the area a solid base for economic stability. There are over 3,000 manufacturing establishments in the area and no industry employs more than 10 percent of the total manufacturing employment. Many raw materials, such as coal, iron ore, lead, barite, silica, limestone, and refractory clay, are found within a 150-mile radius of St. Louis, all contributing to St. Louis' diversified industrial base. It services an economic region which, according to Jurkat's report listed in the preceding paragraph, includes 70 counties in Missouri, 32 in Illinois, 5 in Tennessee, and 8 in Kentucky, in addition to the city of St. Louis. Most industries in the area also serve national markets.

b. Population. Population growth in the St. Louis economic region and in the metropolitan area has been the result of the nation's westward expansion, together with the shift from rural to urban areas. National, regional, and metropolitan area populations since 1910 are shown in TABLE Q-14.

TABLE Q-14
Population
United States, St. Louis economic region, and St. Louis metropolitan area

Year	Population (thousands)			Percent of U. S. total	
	U.S.	St. Louis econ. region	St. Louis met. area	St. Louis econ. region	St. Louis met. area
1910	92,700	3,210	1,032	3.46	1.11
1920	106,800	3,322	1,166	3.11	1.09
1930	123,600	3,554	1,387	2.88	1.12
1940	132,100	3,783	1,464	2.86	1.11
1950	151,700	3,945	1,719	2.60	1.13
1960	180,700	4,258	2,060	2.36	1.14

SOURCE: U. S. Census of Population; "Report on Population, Land Use, and Employment, St. Louis Metropolitan Area" by Dr. Ernest Jurkat.

While there has been an over-all population increase in the region, it will be noted that little of this increase has occurred outside of the metropolitan area. As a result, a regional population decline from 3.46 percent of the nation's population in 1910 to 2.36 percent in 1960 is shown. Although the growth in the metropolitan area's population is at a slightly faster rate than the nation as a whole, its growth is slower than other major urban areas. However, continued growth is indicated.

c. Manufacturing. The St. Louis economic region, being predominantly agricultural, has failed to industrialize at a pace consistent with the national trend. This is reflected in its relative economic decline during the past 60 years. Despite regional decline, the economy of the metropolitan area in terms of manufacturing activity has been expanding even though at a lesser rate than some of its economic competitors. Manufacturing is the most important segment of the metropolitan area's economy. It employs about one-third of the area's total employment and 1.5 percent of the national total in manufacturing. It accounts for about 60 percent of employment working on export goods and materials. Of the \$2,679,258,000 in value added by manufacture produced in 1961, more than half was in food products, transportation equipment, chemicals, and primary metals. Growth in value added by manufacture and corresponding employees are shown in TABLE Q-15.

TABLE Q-15
Value added by manufacture and manufacturing employees
in the St. Louis metropolitan area

	1947	1954	1958	1960
Value added (millions)	\$1,713	\$2,298	\$2,383	\$2,676
Employees	244,481	255,525	243,573	248,280

NOTE: Value added is in 1958 dollars. Values shown in Section III of the main report are unadjusted for price level changes.

42. FUTURE POPULATION TRENDS IN THE ST. LOUIS METROPOLITAN AREA

Comparative population growth trends in the St. Louis metropolitan area and in the nation are shown in TABLE Q-16. The estimates for the United States to year 2020 are the median projections developed by the Economic Task Group of the Interagency Water Resources Council staff. The growth from 2020 to 2070 was an extrapolation of the low projection developed by the Task Group between 1960 and 2020 and amounted to a 1.5 percent annual growth rate. The average annual growth rate of the St. Louis metropolitan area has been approximately 0.1 percent higher than that of the nation between 1910 and 1960. It was assumed that the metropolitan area will continue to grow at a rate 0.1 percent higher than that of the nation to year 2020 and thence increase at the national rate to year 2070.

TABLE Q-16
Population projections of the St. Louis metropolitan area
relative to the United States

Year	Population (thousands)		Avg. annual percent growth per period		Percent of U.S. total
	United States	St. Louis met. area	United States	St. Louis met. area	St. Louis met. area
1960	180,700	2,060	-	-	1.14
1980	254,100	2,990	1.79	1.89	1.18
2000	358,300	4,290	1.73	1.83	1.20
2020	502,000	6,100	1.68	1.78	1.22
2070	1,054,700	13,490	1.50	1.50	1.28

For the purpose of this report, only the growth through the next several decades is of interest. In that time, as thereafter, indications are that population growth will remain strong. As a result, continued expansion of urbanization will be required. With the population more than doubled by year 2000 and in consideration of the areal extent required by new housing, it can be surmised that the areal extent of urbanization will be more than doubled by that time. As a result, the periods discussed in paragraph 39 by which urbanization along lower Meramec River is estimated to occur appear to be assured.

43. FUTURE INDUSTRIAL TRENDS AND AREAL REQUIREMENTS BY INDUSTRY IN THE ST. LOUIS METROPOLITAN AREA

The Meramec Basin Research Project group made a detailed survey and analysis of changing industrial patterns in metropolitan St. Louis and the demand and supply of industrial land to 1980. The results of its analysis are presented in the report listed in paragraph 40b of this appendix. The group found that there are more than 32,000 acres of vacant, excellent industrial sites available for industry in the metropolitan area,

of which approximately 28,600 acres are located in Illinois. The group considers that by about 1980, over 11,000 additional acres of large industrial tracts will be made available on the Missouri side of the Mississippi River because of improved access created by freeways, planned industrial tracts, and urban redevelopment. An appraisal was made of the need for this land by analyzing potential industrial growth to 1980 and the acreage that this growth would require. Census data for 1947, 1954, and 1958 on value added by manufacture and value added per employee for 16 categories of industry were analyzed. Extrapolations of these data to 1980 were modified by questionnaire data obtained from 123 firms in the area. High and low estimates were made for most industries, based primarily on assumed variable changes in other metropolises competitive with St. Louis. Resulting low and high estimates of value added by manufacture in 1958 dollars are \$2,797,000,000 and \$3,098,000,000, respectively. These estimates amount to a 4.5 and a 15.8 percent increase, respectively, over the 1960 value, averaging 10.1 percent. Corresponding low and high estimates of employees in manufacturing in 1980 were estimated to be 192,706 and 227,444, respectively. Based thereon, it is estimated that there will be a reduction in the number of employees working in 1980 varying between 22.4 and 8.4 percent, and averaging 15.4 percent. The reduction is attributed to technological changes in manufacturing. As a result, an increase in value added per employee and number of employees per acre is indicated. The amount of land used by industry for any given output has been rapidly increasing in the past few decades. Reflected in this increase is the use of horizontal production methods, parking space, etc., in addition to increasing productivity per worker. Analysis shows that the number of employees per acre varies with types of industry and their locations. Locational variations are shown by the fact that industries in St. Louis (1954) averaged over 44 employees per acre, whereas those in St. Louis County (1959) averaged only 28 workers per acre. In consideration of likely future requirements, the research group estimated that future construction would be based on 14 employees per acre. Resulting high and low estimates of additional land needed by industry in the St. Louis metropolitan area by 1980 are shown in TABLE Q-17.

TABLE Q-17
Metropolitan St. Louis industrial land requirements to 1980

	Low estimate (acres)	High estimate (acres)
Land in industrial use, 1961	6,000	6,500
Total industrial land needed by 1980 (including relocations)	9,000	18,000
Total new land needed by 1980 (including relocations)	3,000	12,000

The research group concludes that any lack of industrial growth in metropolitan St. Louis cannot be primarily attributed to a scarcity of industrial land. It points out however, that this does not infer that there

is no problem in the preservation, development, and promotion of industrial sites. The group has found that the majority of available sites has not been mapped or analyzed in any comprehensive way. Moreover, the abundance of sites does not insure that they will be available when required. Residential and commercial uses are continually invading prospective industrial land. In addition, prime industrial tracts are improperly zoned for other uses. Further, it is known that there must be more land available than is required in order to facilitate flexibility in the choice of sites and to maintain reasonable prices.

44. DIRECTION OF URBAN AND INDUSTRIAL GROWTH

Principal growths in urban and industrial development within the St. Louis metropolitan area have taken place in Missouri during the past decade. It is difficult to point to any logical set of reasons why there is little demand for locations in Illinois. Preference for residential and commercial construction in Missouri may be attributed to more picturesque surroundings, better established land use plans and zoning laws, and a reputation for lower construction costs. While Illinois industrial sites are generally superior in size of tracts and relative flatness of the land, preference to Missouri sites may be due to some extent to desires concerning work force location, nature of adjacent residential areas, better drainage, and transportation facilities. However, it is considered that the major influence for both residential and industrial location has been the lesser time-distance travel factor. Interstate highway improvements through St. Clair and Madison Counties, together with two new bridges across the Mississippi River, all currently under construction, should improve the travel time between St. Louis and Illinois. However, because of the more advanced stage of highway construction in Missouri, the apparent continuing desire of industry for Missouri plant sites and the fact that employees tend to locate reasonably close to their places of employment favor continued concentration of growth in Missouri during the next decade. While increasing development in Illinois is likely after that time, the inertia of the movement in Missouri should cause it to continue for some time after that. In consideration of these factors and the highway systems under construction to the south and southwest from St. Louis, urbanization along the river by the dates given in paragraph 39 should be assured. In the previously referred to questionnaire survey of industrial firms in the St. Louis metropolitan area made by the Meramec Basin Research Project, it was determined that almost 60 percent of all incoming shipments and over 70 percent of all outgoing shipments are truck hauled. Since the major export markets for many St. Louis industries are to the south and southwest, industrial sites in the vicinity of Meramec River will have a locational advantage over other areas. As urbanization moves closer to the river, an increase in the industrial development now being experienced is anticipated.

45. EFFECT OF URBAN EXPANSION ON MERAMEC RIVER FLOOD PLAIN

With flood protection provided by reservoirs, urban expansion will unquestionably result in the demand for residential and industrial occupancy of select areas of the flood plain. The construction of relatively low levees would be essential to occupancy to provide supplementary protection from the more rare floods, and in the downstream reaches, against Mississippi River backwater. The effect that levee construction would have on the St. Louis County Planning Commission's open space plan was discussed with county officials and the commission's planning staff. The county's plan provides for 32.6 percent of the county area to be placed in open space use. Of the land allocated for open space, about 7 percent or 3,334 acres of land in six areas were discussed as potentially subject to residential or commercial-industrial development. It was the view of the Commission that this consideration appeared to present no conflict with its land use plan. A letter from the commission in this regard is attached as EXHIBIT 1.

46. LAND VALUES IN LEVEED AREAS

Current development in the vicinity of the nine areas indicates that two areas would be in future residential use, two at Fenton and Valley Park in urban-commercial use, three in commercial-industrial use, and two in agriculture. One of the agricultural areas would likely convert to truck farming; the other would remain in its present type of cropping practices. Conversion of the areas to these uses would create an increase in land values. Estimated land values immediately prior to the time of land development would vary between \$250 and \$1,000 per acre. These values reflect increased returns to the farmers from the increase in yields anticipated between the present time and the time land conversion to higher use. Estimated land values in the agricultural areas with reservoir and levee protection provided would vary between \$400 and \$1,000 per acre. It is considered that those in the residential-commercial-industrial areas would be increased to between \$10,000 and \$32,670 per acre based on an analysis of two local areas where there were recent conversions to higher types of development. These areas are in the same market areas and therefore subject to the same general sources of demand, supply, and labor force as are the considered Meramec bottoms areas. The first area analyzed was a local industrial redevelopment (Kosciusko) area, located near downtown St. Louis. Information contained in a 1963 series of articles printed in the St. Louis Globe Democrat indicated that the present re-use value of industrial land in the Kosciusko redevelopment ranges from 95¢ to \$1.25 per square foot for heavy industrial sites, and from \$1.20 to \$1.80 for light industrial sites. However, the articles point out that since these values seem somewhat high in relation to other areas, the re-use land prices are to be re-evaluated by two appraisal firms. The second area analyzed was that protected by the St. Louis Flood Protection Project currently under construction by the Corps of Engineers. Portions of the project area

were, in the past, sparingly used and resembled those in the lower Meramec flood plains in many respects. Information shown in EXHIBIT 2, a statement prepared by Mr. Joseph J. Backers, Valuation Engineer, city of St. Louis, indicated that land previously assessed at \$100 per acre is now selling for 75¢ per square foot. This evaluation does not reflect additional returns to the city in the form of city earnings tax, merchants' licenses, manufacturers' tax, etc., nor does it reflect the intangible benefit of having reversed a downward economic trend attracting a higher income base to a sub-standard area. Based on these data, it is considered that a reasonable maximum value of protected commercial land in Meramec River bottoms will be about 75¢ per square foot. This unit value has been modified downward, depending upon anticipated transportation nets for each area and the likely types of development that will locate in them. Resulting land values for each of the areas are shown in TABLE Q-18.

TABLE Q-18
Land value analysis, levee areas, lower Maramac River

Levee area	2	4	5	7	8	9	11	12	17
Name of area	Telegraph Road	Starling Airport	Butler Lakes	Penton	West Watson Road	Weiss Airport	Valley Park	Peerless Park	Fox Creek
Anticipated land use	Truck farming	Residential	Residential	Urban-Comm.	Commercial	Commercial	Urban-Comm.	Commercial	Agricultural
Degree of levee protection	50-year	50-year	50-year	200-year	200-year	200-year	200-year	200-year	50-year
Estimated initial year of land conversion to higher order of use	1970	1995	1995	1980	1980	1990	1990	1990	1970
Acres subject to flooding	324	705	1,110	66	380	590	500	900	745
Area affected by reservoirs* operating alone									
Acres protected by reservoirs	12	50	0	26	70	235	345	270	215
Acres occupied by existing development within area	0	50	0	26	0	0	345	95	0
Net acreage subject to changed land use within area affected by reservoirs	12	0	0	0	70	235	0	175	0
Dollar unit value of land subject to changed land use**	1,000/ac	-	-	-	750/ac	800/ac	-	850/ac	400/ac
Dollar value of land subject to changed land use within area affected by reservoirs**	12,000	-	-	-	52,500	188,000	-	148,800	0
Area that will be affected by levees excluding that affected by reservoirs - prior to levee construction									
Acres protected by levees alone	312	655	1,110	40	310	355	155	630	530
Acres occupied by existing developments in area protected by levees alone	14	5	0	24	0	11	5	0	0
Net acreage subject to changed land use in area protected by levees alone	298	650	1,110	16	310	344 (sewerage lagoon)	150	630	0
Dollar unit value of land subject to changed land use**	250/ac	300/ac	450/ac	650/ac	650/ac	700/ac	700/ac	700/ac	400/ac
Dollar value of lands subject to changed land use in area protected by levees alone**	74,500	195,000	499,500	10,400	201,500	240,800	105,000	441,000	0
Area that will be affected by reservoirs and levees - prior to levee construction									
Total acreage subject to changed land use	310	650	1,110	16	380	579	150	805	0
Total dollar value of land subject to changed land use**	86,500	195,000	499,500	10,400	254,000	428,800	105,000	589,800	0
Area affected by reservoirs and levees after construction									
Acres required for levee right-of-way	45	49	93	6***	32	51	46	62	14
Net acreage subject to changed land use	265	601	1,017	10	348	528	104	743	0
Dollar net value of land with changed land use	1,000/ac	10,000/ac	10,000/ac	20,000/ac	65c/sq.ft.	65c/sq.ft.	60c/sq.ft.	75c/sq.ft.	400/ac
Total dollar value of land with changed land use	265,000	6,010,000	10,170,000	200,000	9,848,400	14,942,400	2,714,400	24,296,100	0

* Union, Maramac Park, and Pine Ford reservoirs.

** In initial year of levee project operation.

***A total of 22 acres will be required. For analysis purposes, the cost of the incremental 16 acres and developments have been included in the project costs in lieu of negative benefits.

SECTION IX - FLOOD DAMAGES - FUTURE CONDITIONS WITH IMPROVEMENT

47. RESIDUAL FLOOD DAMAGES WITH RESERVOIRS IN OPERATION

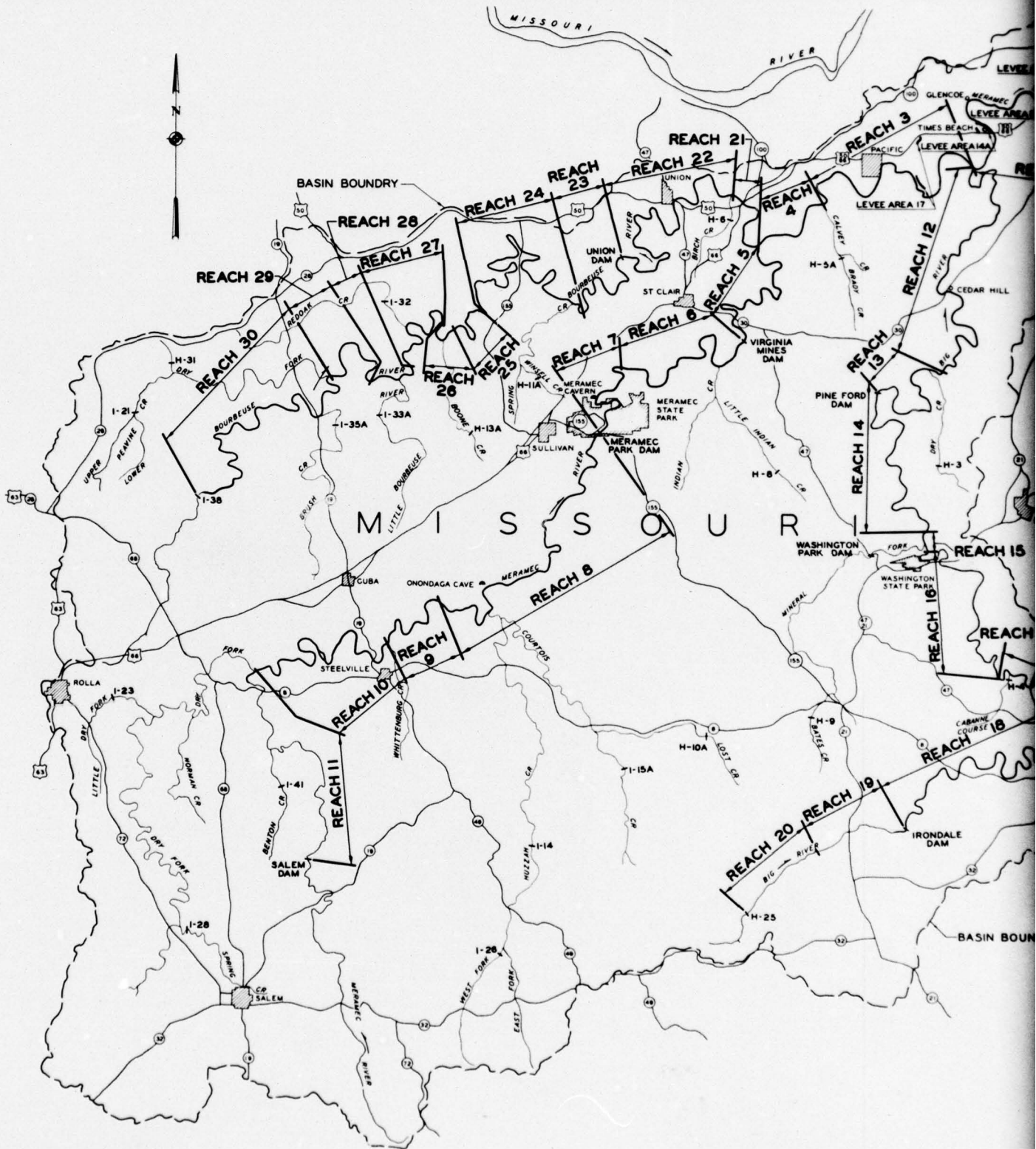
Flood damages that would remain with reservoirs in operation but without levees were derived using the same general procedures used in the previously described flood damage determinations for present conditions and future conditions without improvement. Heights of flooding were obtained from flow frequency profiles modified by reservoir operation. Future yields and distributions for conditions without improvement constructed were used in deriving the agricultural damages. Resulting average annual damages by reach are shown in TABLE Q-19. Total residual average annual damages amount to \$606,800.

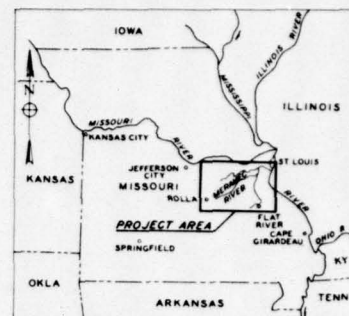
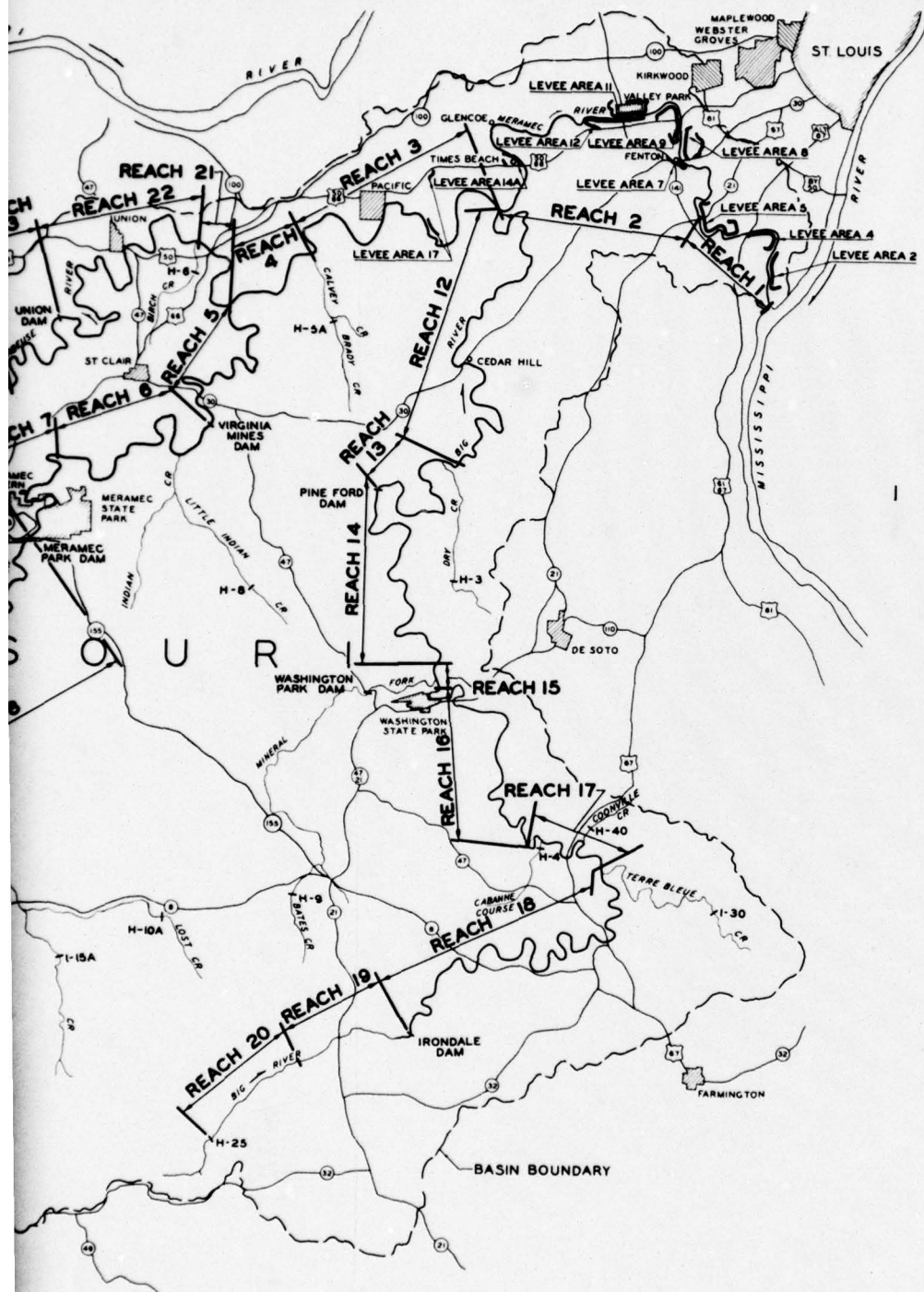
TABLE Q-19
Average annual damages - future conditions with reservoir improvements
Meramec River Basin

Damage reach	Agric. \$	Urban \$	Farm sets \$	Clubhouses \$	Roads \$	Railroads \$	Bridges \$	Fences \$	Equip. & Livestock \$	Erosion \$	Total \$
MERAMEC RIVER & TRIB. STREAMS											
1	15,400	27,800	100	500	2,600	3,500	0	1,800	0	0	51,700
2	39,500	8,900	0	1,000	4,400	3,800	200	2,500	100	100	60,500
3	26,600	0	0	0	600	1,100	0	2,100	0	0	30,400
4	7,700	0	0	0	100	0	0	600	0	0	8,400
5	18,300	0	0	0	200	400	0	1,700	0	0	20,600
7	0	0	0	0	0	0	0	0	0	0	0
10	44,700	1,300	500	1,000	900	0	100	4,200	400	400	53,500
11	24,000	0	3,400	0	3,000	0	0	3,000	600	600	34,600
Fenton Creek	0	38,600	0	0	0	0	0	0	0	0	38,600
Benton Creek	400	0	100	0	100	0	0	100	0	0	700
Calvey-Brady Creeks	400	0	0	0	0	0	0	100	0	0	500
Indian-Little Indian Creeks	0	0	0	200	100	0	0	100	0	0	500
Courtois Creek	1,000	0	100	0	100	0	0	300	0	100	1,500
Lost Creek	3,000	0	0	0	200	0	0	300	0	0	3,500
Huzzah Creek	0	0	0	0	0	0	0	0	0	0	0
Dry Fork-Spring Creeks	85,500	0	0	0	900	0	0	7,400	0	0	93,800
Little Dry Fork Creek	3,900	0	0	0	100	0	0	400	100	100	4,500
Subtotal	270,400	76,600	4,200	2,700	13,300	8,800	300	24,600	1,100	1,300	403,300
BIG RIVER & TRIB. STREAMS											
12	41,000	0	0	100	3,600	0	0	3,200	0	0	47,900
13	9,000	0	0	0	200	0	0	700	0	0	9,900
17	1,800	0	100	0	700	400	0	300	0	0	3,300
18	2,900	0	0	0	900	800	300	500	500	400	6,300
20	6,000	0	2,400	0	2,400	0	0	500	100	0	11,400
Terre Bleue Creek	1,600	0	2,200	100	0	0	100	200	200	200	4,600
Dry Creek	400	0	0	0	0	0	0	0	0	0	400
Cabanne Course Creek	300	0	200	0	0	0	0	0	0	0	500
Mineral Fork-Bates Creeks	1,100	0	0	0	0	0	0	300	0	0	1,400
Subtotal	64,100	0	4,900	200	7,800	1,200	400	5,700	800	600	85,700
BOURBEUSE RIVER & TRIB. STREAMS											
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	100	600	100	0	0	0	800
26	6,200	0	0	0	200	0	0	600	0	100	7,100
27	15,200	0	300	0	600	0	0	1,200	0	200	17,500
28	10,500	0	300	0	200	0	0	800	0	100	11,900
29	17,400	0	200	0	200	0	0	1,400	100	200	19,500
30	9,300	0	0	0	300	0	0	900	0	0	10,500
Spring-Winsel Creeks	0	0	0	0	0	0	0	0	0	0	0
Boone Creek	0	0	0	0	0	0	0	0	0	0	0
Redoak Creek	1,700	0	300	0	400	0	600	200	0	100	3,300
Little Bourbeuse River	7,000	0	800	0	200	0	600	700	0	100	9,400
Dry Fork-Peavine Creeks	25,300	0	3,500	0	900	0	600	2,000	0	700	33,000
Birch Creek	2,900	0	100	200	0	200	0	200	0	0	3,600
Brush Creek	1,100	0	0	0	0	0	0	100	0	0	1,200
Subtotal	96,600	0	3,500	200	3,100	800	1,900	8,100	100	1,500	117,800
Total	431,100	76,600	14,600	3,100	24,200	10,800	2,600	38,400	2,000	3,400	606,800

48. FLOOD DAMAGES IN CONSIDERED LEVEE AREAS WITH RESERVOIRS IN OPERATION

Because the procedure for deriving flood prevention benefits creditable to levee works is based upon the difference in land values before and after levee construction and since the detrimental effect of flooding on returns from the land is inherent in the value of the land, no estimates of flood damage within the leveed area were derived except for land already developed and not subject to changed land use. Average annual damages with reservoirs in operation on those parts of the considered levee areas already developed and not subject to changed land use were derived by previously described procedures and amounted to \$11,100 in Area 2, \$5,500 in Area 4, \$38,600 in Area 7, \$1,000 in Area 11, and \$600 in Area 17.





VICINITY MAP
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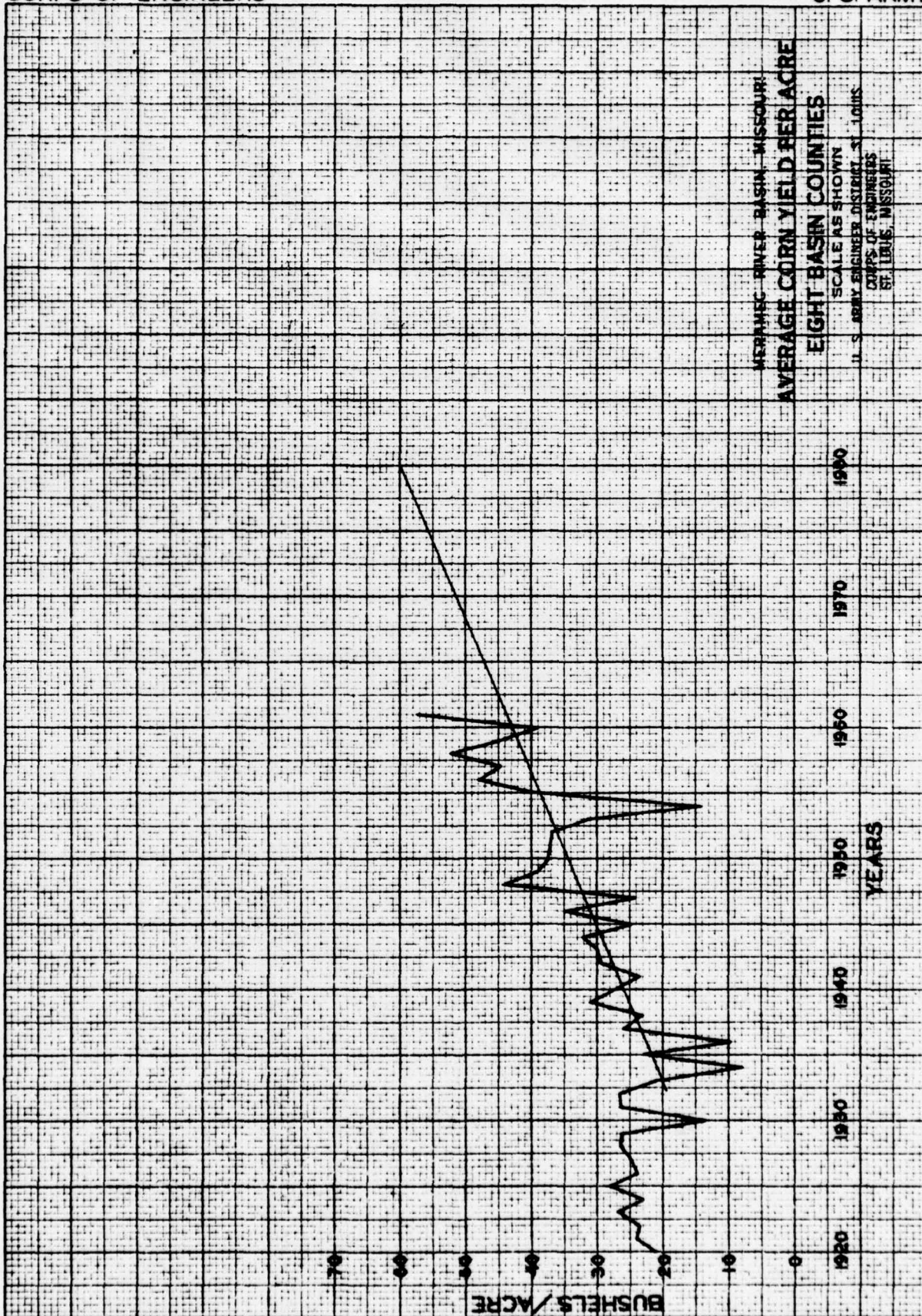
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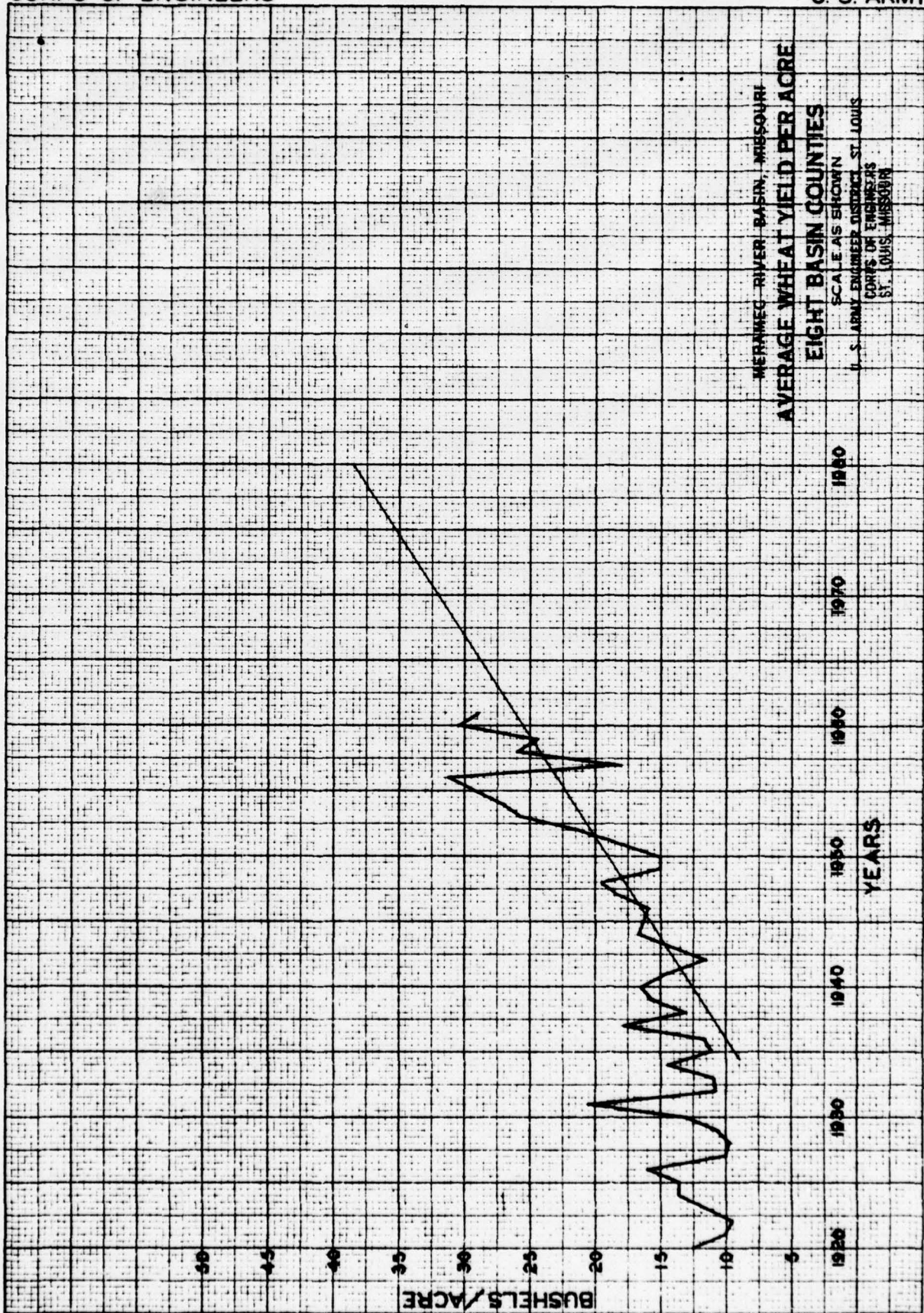
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AREAS SUBJECT TO FLOODING**

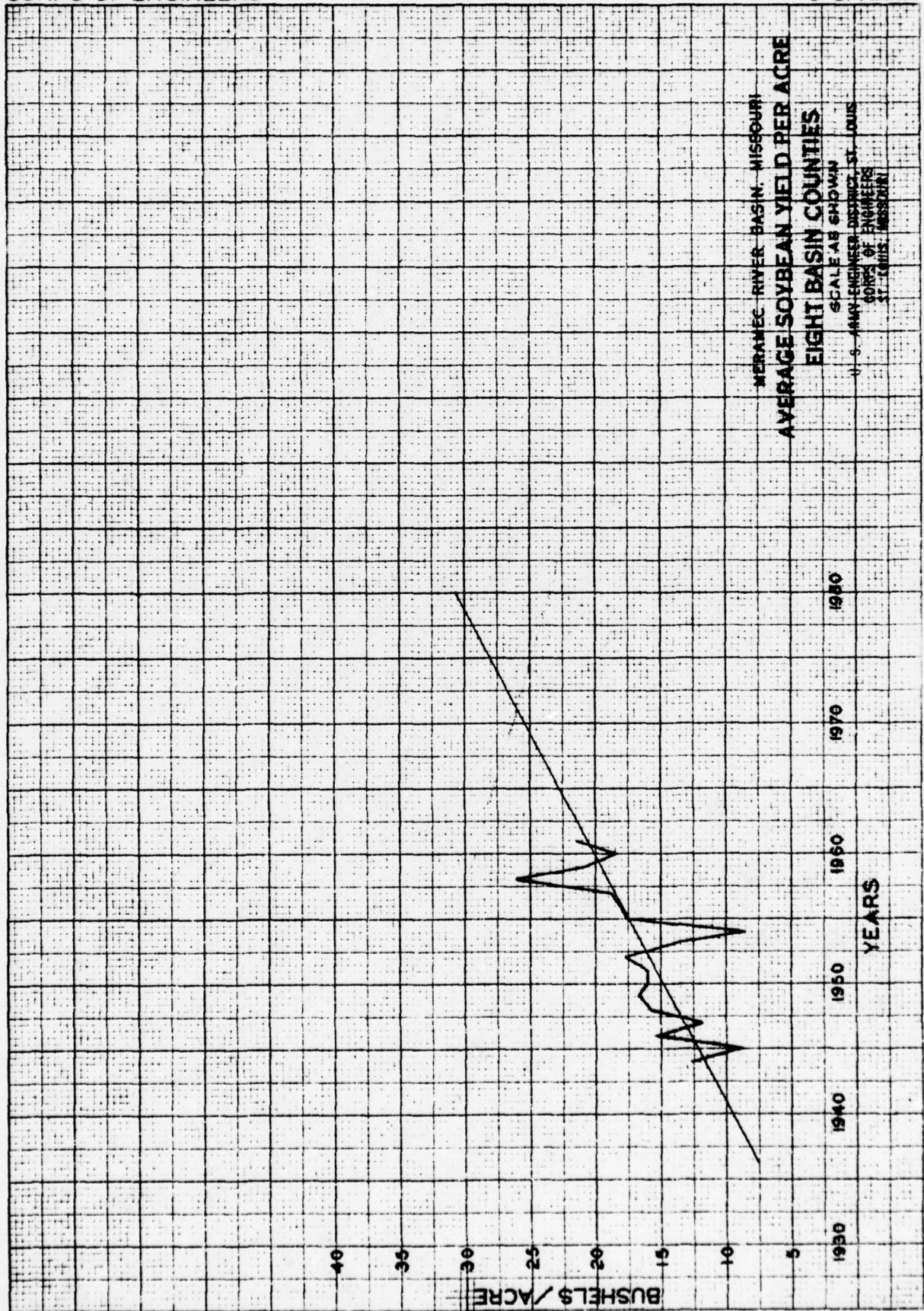
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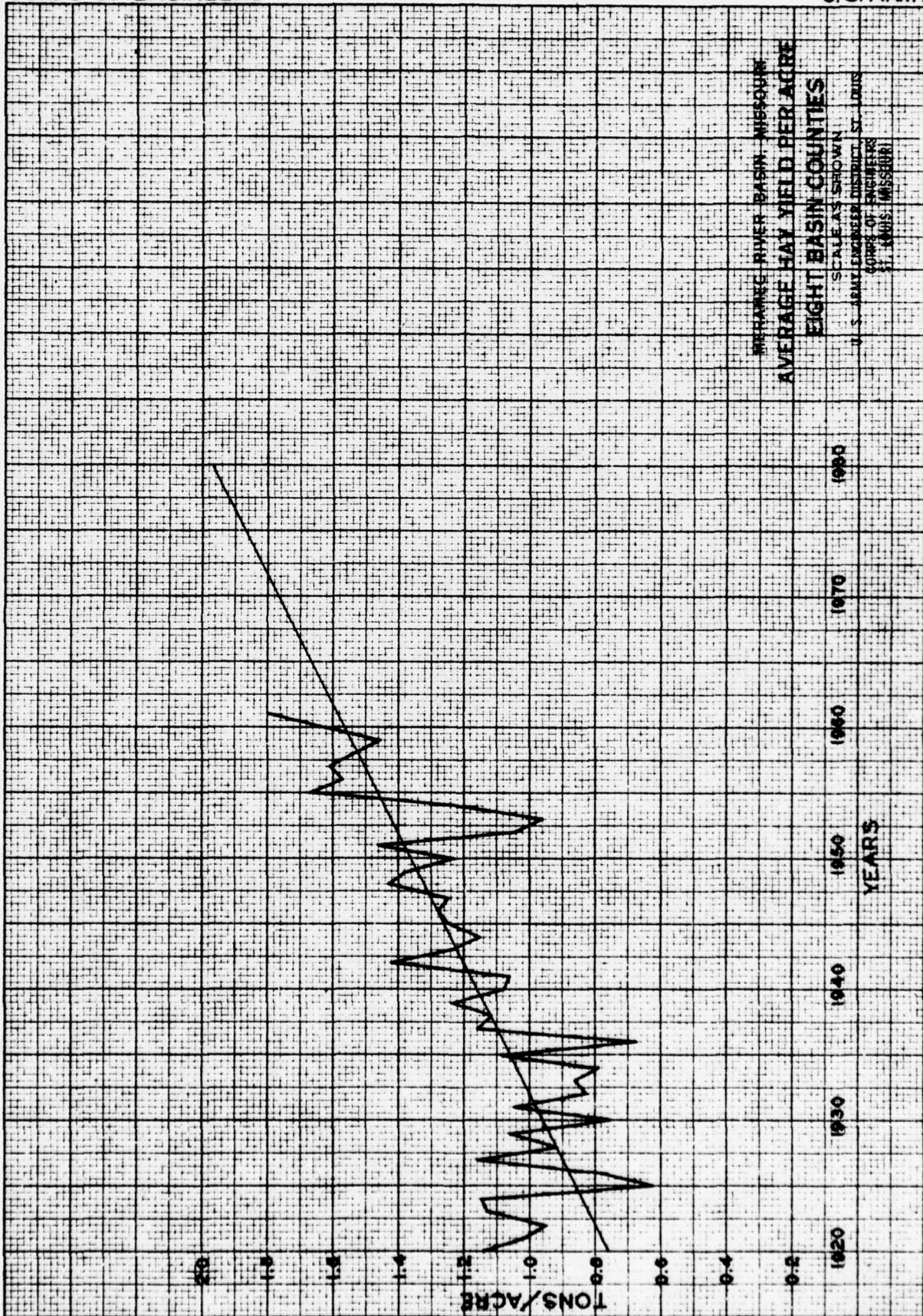
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U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

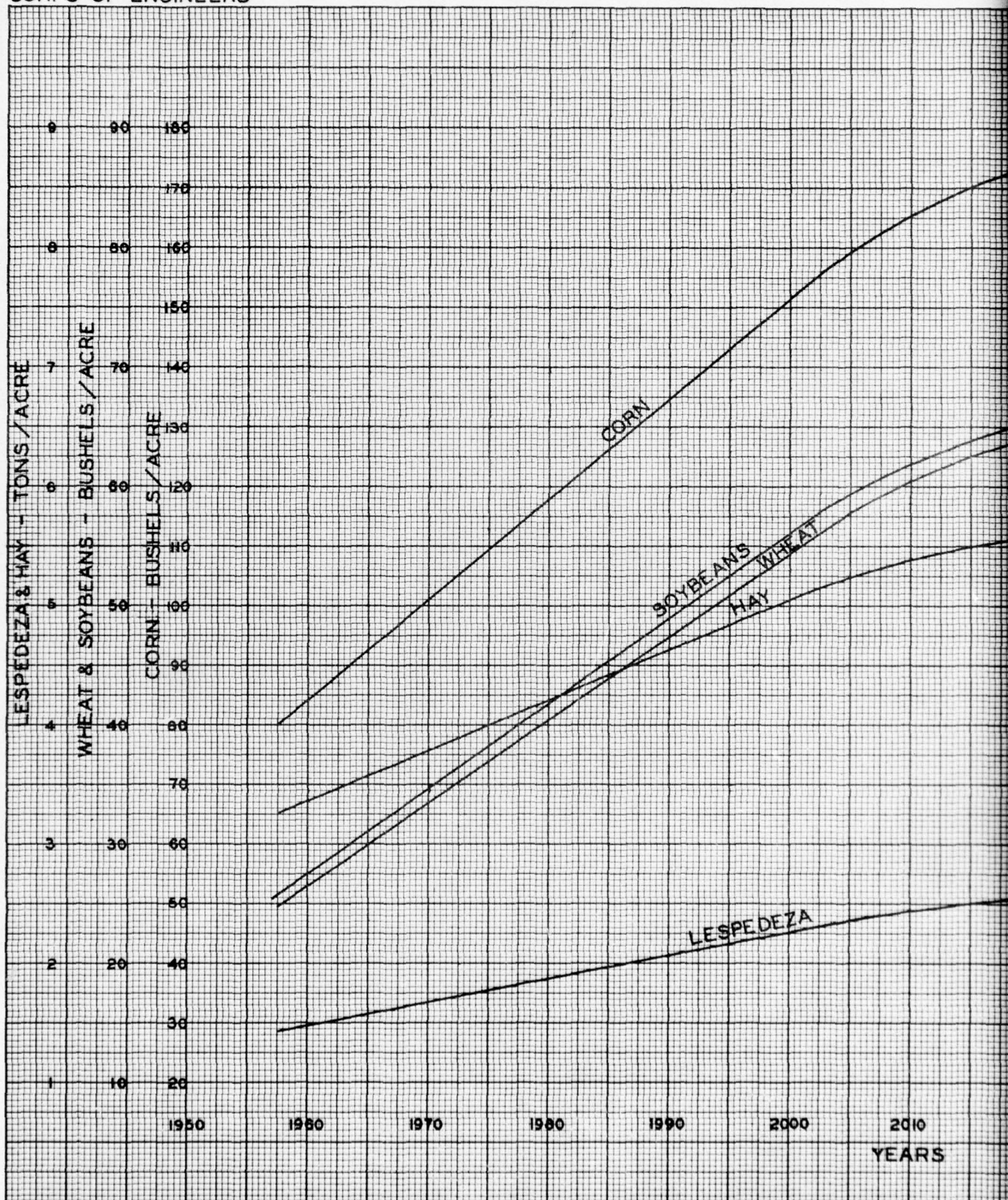


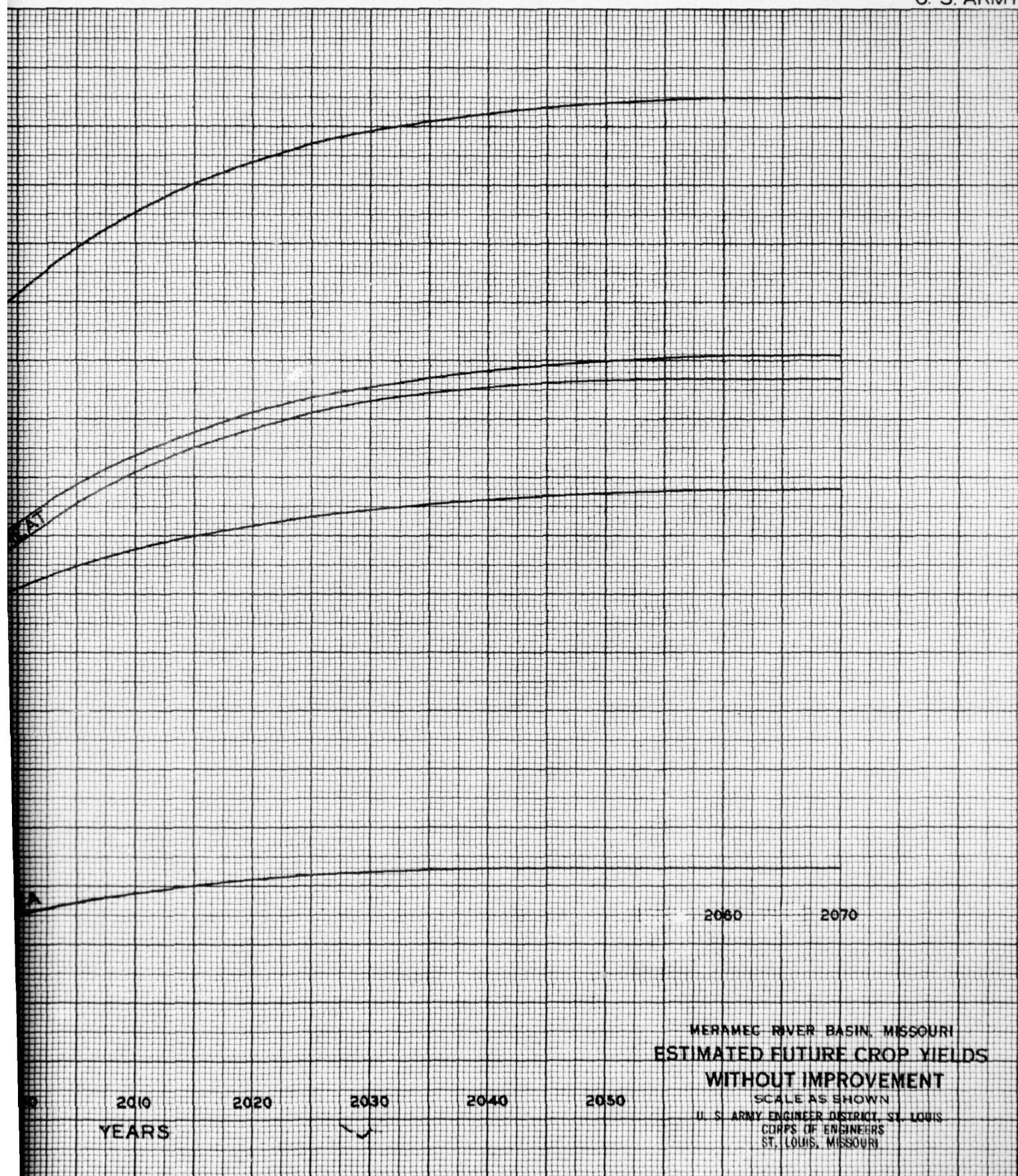






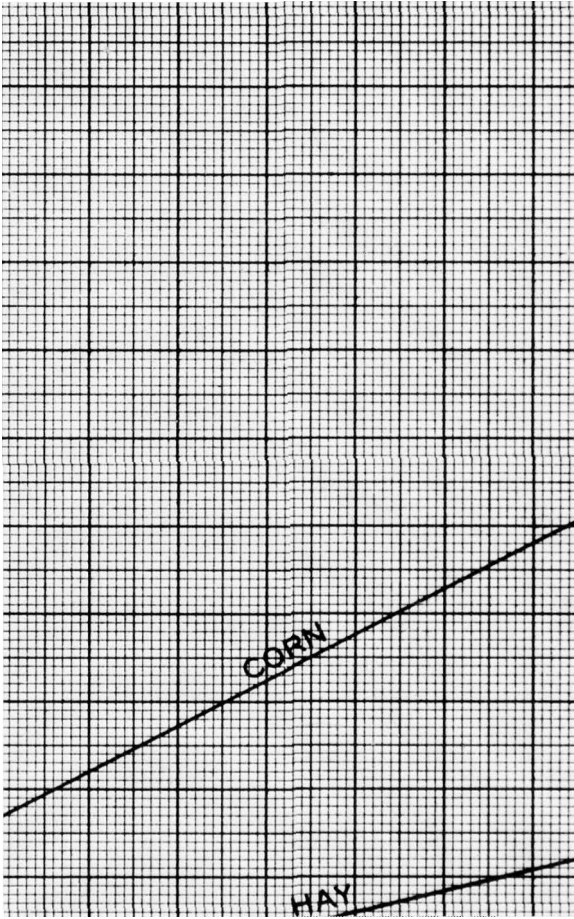
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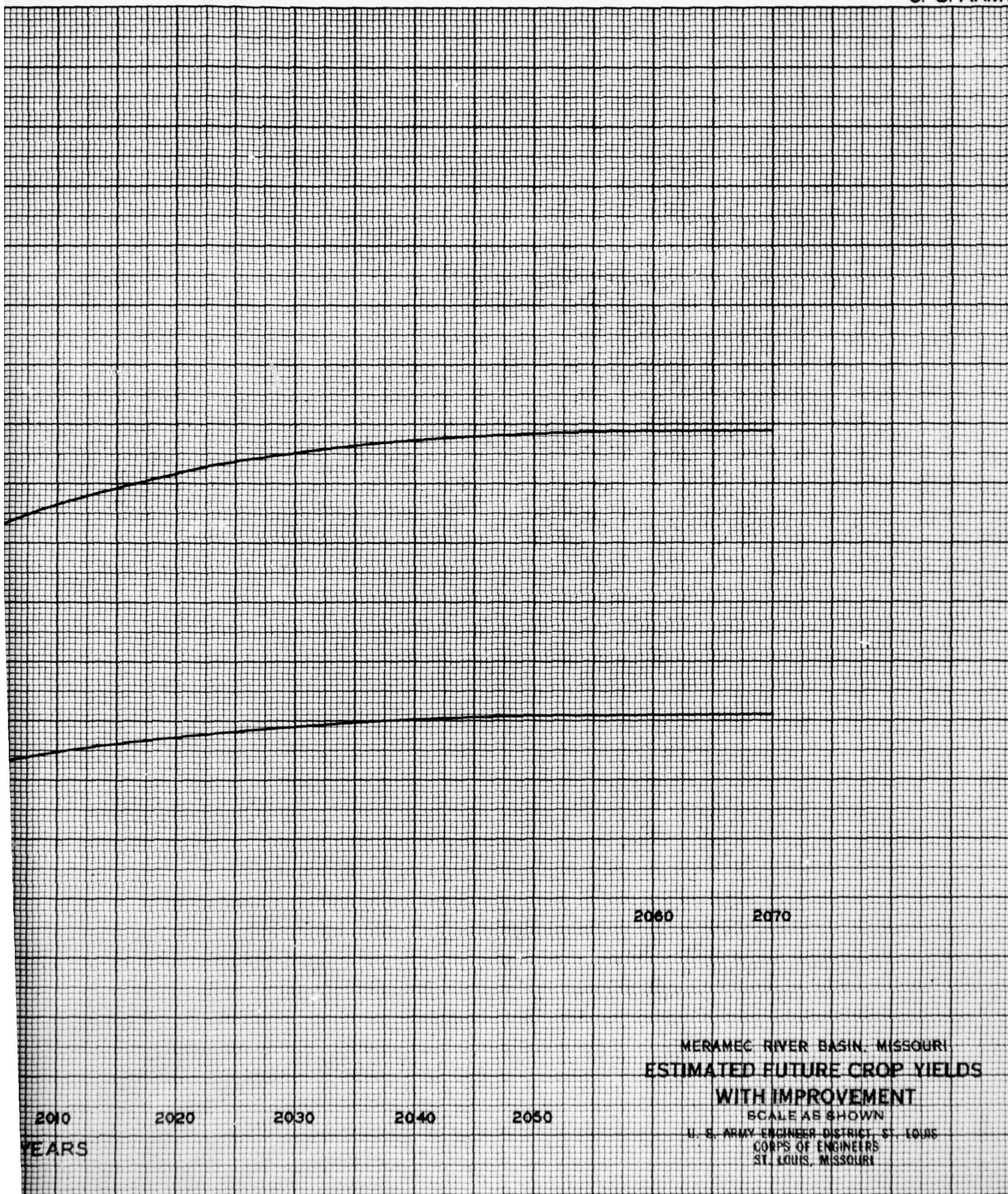




MERAMEC RIVER BASIN, MISSOURI
ESTIMATED FUTURE CROP YIELDS
WITHOUT IMPROVEMENT

SCALE AS SHOWN
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI





COMPREHENSIVE REPORT

MERAMEC RIVER BASIN,
MISSOURI

APPENDIX R

EVALUATION OF BENEFITS

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COMPREHENSIVE REPORT
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APPENDIX R

EVALUATION OF BENEFITS

SECTION I - INTRODUCTION

1. PURPOSE

The purpose of this appendix is to explain the derivation of benefits attributable to the proposed plan of improvement for the Meramec River Basin. All monetary estimates of benefits are based on July 1963 price levels.

2. TYPES OF BENEFITS

Tangible benefits consist of flood control, water quality control, water supply, recreation, fish and wildlife conservation, and area re-orientation. Operation of the reservoirs for low-flow augmentation will provide incidental benefits to navigation during low-flow periods on the Mississippi River. Flood control benefits include reduction of flood damages, increased returns to cropland, and increased land value in the Meramec River flood plain and reduction of flood crests in the Mississippi River. Area reorientation benefits reflect the economic impact that the reservoirs would have on the alleviation of unemployment and the economy of the upper basin.

3. BASES FOR EVALUATION

The basin plan of improvement selected for final study and economic justification consists of 7 main stream reservoirs, 12 tributary stream reservoirs, 12 headwater reservoirs, 26 angler-use sites, and 9 local protection projects. The bases for evaluating the benefits creditable to the various elements in the basin plan are described in the following subparagraphs:

a. Flood control. Flood damage reduction benefits have been derived as the damages that would be prevented by the improvements under future land conditions that would prevail without the improvements. Increased return benefits to cropland, due to intensified cropping practices and timberland conversion, were derived as the difference in estimated net returns received under future conditions with and without the considered improvements. No flood control benefits were credited in areas subject to inundation by the reservoirs. Increased land values in the levee areas were based on the difference between the estimated value of leveed land after conversion to a higher order of use category and the estimated future value of land with reservoirs but without

levees. The benefits attributable to the reservoirs for reducing flood crests along the Mississippi River below the mouth of the Meramec River are those for Meramec Basin reservoirs in the "Mississippi River Reservoir Benefit Study", adjusted by price level changes.

b. Water quality control. Water quality control benefits include the value of low-flow augmentation in the downstream reaches and the ponding effects that the reservoirs have in reducing the low-flow requirements. The U. S. Public Health Service, in cooperation with the Bureau of Mines, U. S. Forest Service, the Missouri Water Pollution Board, and the Missouri Division of Geological Survey and Water Resources, determined flow requirements for all reaches of main stream and principal tributaries in the three sub-basins under future conditions with and without reservoirs in operation. Flow requirements for future conditions with reservoirs in place, less the base flow, represent the needs to be supplied by reservoirs. The value of these needs was based on the cost of a single-purpose reservoir constructed at the same site of the reservoir used by the Public Health Service in its routings to determine stream flow requirements. The value of the ponding effects was based on the difference in costs between a single-purpose reservoir, providing the required flows both with and without the reservoir in place.

c. Water supply. The Public Health Service, in its evaluation of future municipal and industrial water supply requirements, determined that during the study period, a need for supplemental water supply would occur only in the lower basin area. The value of this water was based on the least costly alternative of securing equivalent needs by pumping from the Missouri River to the service area under consideration.

d. Recreation. General recreation was treated separately in this study and does not include the recreational aspects of fish and wildlife. Visitor-day attendance for general recreation is related to demands generated by the population within the zone of influence as of 1970, with the assumption that all 31 reservoirs are in operation at that time. Annual attendance at these reservoirs was estimated by the Bureau of Outdoor Recreation and the National Park Service, and was coordinated with the U. S. Forest Service, Missouri State Park Board and the Corps of Engineers. For the purposes of this report, only the visitor-day attendance creditable to the public use facilities that would be provided by the Corps of Engineers in accordance with Section 4 of the Flood Control Act of 1944, as amended, was used. General recreation benefits were then determined based on the applicable annual visitor-day attendance times the value per visitor-day as established by the Bureau of Outdoor Recreation. Total first costs, accruing visitor-day attendance, and creditable benefits for other interests, including State and local governmental units and private interests were not used as part of the project benefits since no commitments could be obtained for the phasing of the capital investment.

e. Fish and wildlife. The recreational aspects of fish and wildlife associated with the various basin elements under consideration were furnished by the U. S. Fish and Wildlife Service in cooperation with the Missouri Conservation Commission, U. S. Forest Service and Corps of Engineers. Evaluation of attendance creditable to the pertinent basin elements was based on the difference between the fishing and hunting use of the area or reach of stream with and without the project under consideration. Fishing and hunting benefits were determined based on the applicable net annual visitor-day attendance times the applicable unit-value for the type of resource(s) involved. The worth of the visitor-day attendance is in accordance with the formula contained in the Interim Schedule of Values for Recreational Aspects of Fish and Wildlife as adopted by the Inter-Agency Committee on Water Resources.

f. Area reorientation. Area reorientation benefits that would accrue to the reservoirs were divided into two general categories. The first is applicable only to those reservoirs located in counties designated as eligible for assistance under the Area Redevelopment Act and includes benefits that would be derived from local employment during construction of the dams and facilities and subsequently for the operation and maintenance of the reservoirs. These benefits were based on the savings in unemployment compensation. The amount of savings was assumed as equivalent to the value of the wage component for local labor since it is a primary means of providing work opportunities for those presently on relief rolls. The second category of benefits is applicable to all reservoirs and is a measure of the new job opportunities that would be created by the improved economic conditions. The value of these benefits was measured in terms of wages that would accrue to the local economy from the monies spent by the recreationists and the net effect that recreation, as a new business, would have on the total local economy by creating new demands in terms of jobs and special services.

g. Navigation. Operation of the reservoirs for low-flow augmentation in the interest of water quality, water supply, and improved stream fisheries will provide incidental benefits to navigation on the Mississippi River during low-flow periods. Routings of reservoir withdrawals indicate the releases will augment low-flow deficiencies in the Mississippi River and by 2045 provide equivalent releases, measured in terms of storage, as is credited the Meramec Basin in the report on "Mississippi River Reservoir Benefit Study". The value of this benefit was based on the unit value per acre-foot of storage as contained in the referenced study times the storage required for a reservoir to meet the other downstream demands.

4. EVALUATION OF FUTURE REQUIREMENTS AND CONVERSION TO AVERAGE ANNUAL VALUES

An analysis was made of the basin's anticipated growth and needs for a 100-year period with 1970 as the base year. In evaluating the

worth of future requirements, the basin's demands were divided into short- and long-term needs. Estimates for each project purpose were analyzed as to reliability and practicality within the over-all scale of anticipated development. Benefits that accrue at varying rates in the future were discounted to the base year and distributed as an equivalent uniform annual value over the period of analysis. The interest rate used is 3 percent. Flood control benefits include value of flood damages prevented by the projects and a future increase in returns after construction of the projects due to improved cropping practices, higher yields and conversion of land to a higher use with greater returns. The latter value has been discounted to reflect only those areas susceptible to change, the degree of participation by the landowners and the time lag of conversion and attainment. The demands on which water quality and water supply benefits were based were divided into four 25-year increments. These increments represented reasonable periods of time that a prudent user would be likely to adopt in extending development in the service of a need. The first 25-year increment was selected as the immediate or short-term basin need and its value based on the cost of providing this need by the selected alternative means. The remaining three increments of demand were regarded as future or long-term needs. Their value was based on the incremental cost of enlarging the base alternate development to provide these additional requirements, discounted to reflect the time differential between time of need and the economic base year. All recreational attendance estimates and benefits credited to the projects are the expected initial visitation for 1970. Projections for future growth and ultimate attendance expected to occur within the study period were not used in project formulation because they could not be made with any reasonable accuracy or expectation of achievement. Area reorientation benefits include: the present value of the wage component paid to local labor from both the project construction activities and from the money spent by the recreationists once the reservoir is in operation; the value of labor costs for reservoir operation and maintenance discounted to reflect a uniformly decreasing value over a 10-year period of economic recovery; and the value of economic growth discounted to reflect a 20-year limitation to insure that the economic development is strictly applicable to the reservoirs and not secondary in nature. Storage provided for reach M-7 demands (lower Meramec River) was the basis for the navigation benefit evaluation and depended upon the reservoir's operational requirements for downstream releases. The flow requirements were divided into 25-year increments and summated until the releases in terms of storage required were equal to that contained in the report "Mississippi River Reservoir Benefit Study". The value of this storage was determined by multiplying the storage by the unit value per acre-foot and discounted to reflect the time differential between time of release and the economic base year, 1970.

5. ALLOCATION OF BENEFITS

Benefits were allocated on the basis of identifiable and measurable effects. Benefits were credited a specific project when analysis

indicated a capability to meet a specific basin need. Where benefits are creditable to more than one project, the benefits were prorated in relation to each of the multiple units' contribution to the purpose served. Mississippi River flood control benefits previously assigned to the Meramec Basin in the "Mississippi River Reservoir Benefit Study" were credited to the main stream reservoirs on the basis of drainage area controlled and flood control storage provided. In no case were these benefits prorated to a reservoir where the frequency of protection provided was less than once in 100 years. Where more than one reservoir contributes to flood reduction in the Meramec River flood plain, the benefits were allocated to each project in proportion to its capability in affecting flood reductions when acting alone. Benefits for local flood protection were credited to the individual project based on damages prevented over and above those eliminated by and credited to reservoirs and increased values of land which would result from protection. Benefits creditable to the supplemental water quality and water supply needs were divided into two parts: the benefits applicable to needs in the upper reaches of stream in each of the three sub-basins; and the benefits applicable to the needs in the lower area of the Meramec River, reach M-7. Benefits for needs in the upper basin area were allocated to main stream and tributary stream reservoirs on the basis of their contribution to flow requirements. No storage was dedicated for water quality and water supply in the head-water reservoirs since the size of drainage area involved was not sufficient to guarantee meeting the needs over the basin's critical period. Consequently, no supplemental water quality or water supply benefits were allocated to these reservoirs. Allocation of water quality benefits in the lower Meramec River followed the division of flows used by the Public Health Service in its routing studies for determination of needs; i.e., approximately one-third from the Big River Reservoir system and two-thirds to the Meramec River Reservoir system. The system benefits, in turn, were allocated to the individual reservoirs on the basis of their contribution to the system requirements. Water supply benefits in the lower Meramec River were allocated on the basis of the reservoir's individual contribution to the supplemental flow requirements. Recreation benefits, including the recreational aspects of fish and wildlife, were assigned directly to individual projects on the basis of attendance. The method of allocating area reorientation benefits depended upon the category of benefit involved. Those based on savings in unemployment compensation were assigned directly to the individual reservoir as appropriate. Those representing the new job opportunities that would be created by the reservoirs were allocated to all reservoirs on the basis of applicable general recreational attendance. Navigation benefits were assigned directly to individual reservoirs in proportion to their contribution to water needs for reach M-7. The number of reservoirs so credited was limited by a time factor, the year 2045, when the sum of reservoir releases was equivalent to the total low-flow augmentation in the "Mississippi River Reservoir Benefit Study".

SECTION II - RESERVOIR BENEFITS

6. FLOOD CONTROL

a. General. Flood control benefits were evaluated for all land in the flood plains below the uppermost damsite on tributary and headwater creeks on which a plan of improvement was considered, as well as on 30 reaches along the three major streams. The land use distribution for each area was obtained from flood plain land use maps contained in APPENDIX B and from additional land use maps developed by use of aerial photographs and U. S. Geological Survey quadrangle sheets. All land was classified as crop and pasture, urban and recreation, or timber and other areas. The total number of acres in the basin subject to flooding is approximately 129,400, of which 10,500 acres in the lower portion of the Meramec River are subject to backwater flooding by the Mississippi River. Of the total flood plain acreage, 79,300 acres are in crop and pasture, 3,800 acres are in urban and recreational use, and the remaining 46,300 acres are in timber or other. The acreage and percent distribution of each classification are given in TABLE R-1.

b. Flood damages prevented. Flood damages with and without protection are based on future values that would prevail without flood control improvements. Tangible damages were determined for the following categories: agriculture, urban and scattered residences and commercial establishments, recreation facilities, rural non-agriculture, roads, railroads, and bridges. In addition, intangible damages were included, such as loss of life and detrimental effects to health and normal operations, for which no monetary value has been determined for this report. Crop damages were determined by the method developed by the Office, Chief of Engineers, and outlined in memorandum, ENG CW-E, dated 30 September 1960, subject: "Flood Hydrograph - Damage Integration Method of Estimating Flood Damages in Agricultural Areas". In this method, crop damages were separated into losses of "direct production investments" (DPI), which include investments in preparation of ground, seeds, planting, cultivation and care, and "losses of income" (LI). Area flooded-percent chance of occurrence curves were drawn from area-elevation curves computed from U. S. Geological Survey sheets and flood frequency profiles. Using the above data and the generalized seasonal distribution of the number of flood rises and recessions, the average annual crop damage was determined for the cultivated acres shown in TABLE R-1. Urban and scattered residential and commercial damages were developed from damage-elevation-frequency relationships. Initial surveys were made to establish the start of damage elevation of each residence, industry, and commercial establishment. Interviews were then conducted with each industry and commercial establishment to obtain indications of the probable flood damages to buildings and facilities, equipment, inventory, loss of non-recoverable business, loss of wages to employees, and cost of flood fight and cleanup. Depth of flood-value of residence relationships were used to evaluate damages to homes and contents. Average annual damage to farm sets was estimated at \$160 and the number of these units was obtained from county maps published by the

Missouri State Highway Department and the U. S. Bureau of Public Roads. Average annual damages to clubhouses were estimated at approximately \$25 per unit. The number of clubhouses was also obtained from county highway maps. Fence damage was estimated at \$4 per crop-acre and was applied to the average annual number of crop-acres flooded. County highway engineers were interviewed to determine the extent of road damage due to floods. The monetary damage varied considerably with the type of road construction. Those roads in the flood plain of the lower Meramec River are generally of better quality than those along the Big and Bourbeuse Rivers and the upper reaches of the Meramec River. Also, the quality of the roads along the tributary creeks decreases as compared with those along the main stems. Damage values per flooding, ranging from \$150 per mile of inundated road along the tributary creeks to \$450 per mile in the lower Meramec River bottoms, were used. The lengths of roads in the flood plain and their elevation were determined from county highway maps and U. S. Geological Survey sheets. Through coordination of these data and elevation-frequency flood profiles, average annual road damages were determined. Average annual bridge damages were estimated from data obtained from county highway engineers. Damages to farm equipment, loss of livestock, and the cost of repair of farm ditches and dikes were estimated from data obtained from farmers during field interviews. Based on reported damages experienced in the past by railroad companies having track in the Meramec Basin flood plain, together with railroad bed profiles obtained from these companies, the average annual damage to railroads was determined. The average annual damages for the above categories are summarized by damage reach in TABLES R-2 and R-3 for future conditions, without and with improvement, respectively. The total average annual flood damages prevented by the reservoirs equal the difference between future average annual damages with and without improvement. These amount to \$1,501,000 for the entire basin and are shown in TABLE R-4.

c. Increased returns to cropland. With flood protection provided, it is anticipated that more intensive agronomic practices and converted timberland will develop with resulting increases in returns from the land. Whether for conditions with or without the improvement, the actual net returns received equal the net returns that could be obtained from flood-free land minus flood damages. The difference between actual net returns received with and without the improvements equals flood damages prevented plus increased return benefits. Assuming 100 percent participation by farmers in intensification of cropping practices, increased return benefits are obtained by subtracting flood damages prevented. The consensus of opinions of farmers is that they will perform more intensive cropping practices and convert timber and wasteland to cropland where flooding occurs no more frequently than once in five years. This general criterion was used in selecting the

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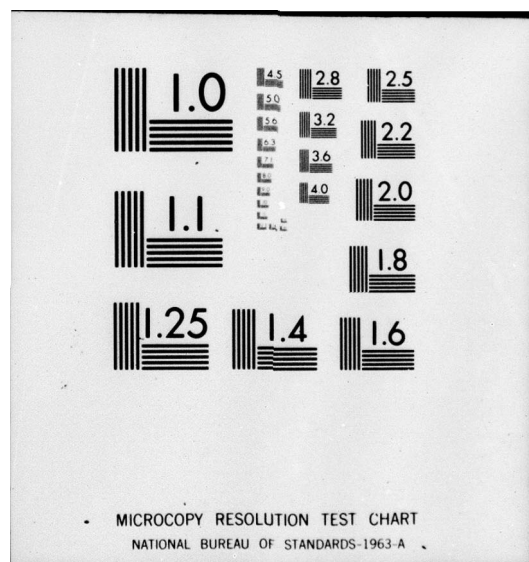
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reaches in which changed land use might be affected. Since the alleviation of flooding will affect these acreages in varying degrees, depending on their elevations, it was assumed that a measure of the degree of farmer's participation is the amount of average annual flood damage reduction affected. This percentage is approximately equal to the percent reduction in the average annual acres flooded. Experience has also shown that even after construction of an improvement that affords substantial flood reduction, there is a reluctance on the part of some farmers to change their existing ways of farming. Even in some of the most progressive farming areas, complete participation in changed cropping methods cannot be expected. It is estimated that a maximum of 80 percent of the land would be subjected to these advanced practices. Resulting benefits also reflect an estimated 15-year lag in their attainment. A 3 percent interest rate was used in the discounting computation. Total average annual increased return benefits amount to \$459,900 and are summarized in TABLE R-4.

d. Sample calculation - damage reach 2. The procedures used in deriving flood damages prevented and increased return benefits are summarized in the following subparagraphs, using damage reach 2 as an example. The method of evaluation is typical of that used for all other damage reaches in the basin.

(1) Agricultural damages prevented. Average annual crop damage, without improvement of \$125,300 (TABLE R-2), would be reduced to \$39,500 (TABLE R-3) with improvement, resulting in an annual benefit of \$85,800.

(2) Property damage prevented. Average annual property damage of \$309,500 (TABLE R-2) would be reduced to \$21,000 (TABLE R-3) under conditions with the plan of improvement in operation. Total property damage prevented amounts to \$288,500 annually.

(3) Increased return benefits. Based on the cropping characteristics and net returns contained in TABLE R-5, annual increased return benefits were evaluated as shown in TABLE R-6 and amount to \$56,900. The expected income on timberland was estimated at \$5 per acre. The estimated annual cost of converting timberland to cropland was estimated at \$7.63 per acre.

e. Mississippi River flood damages prevented. In the "Mississippi River Reservoir Benefit Study", the monetary value of benefits assignable to the three reservoirs contained in the 1949 Meramec River Basin Report was \$519,600. This value, adjusted for price level changes from 1956-1958 to 1963 data, increased to \$598,600. On the basis of drainage area controlled, flood control storage provided, and operation during hypothetical floods, the Mississippi River flood control benefits provided by the present considered plan of improvement are \$517,800.

f. Total flood control benefits to reservoirs. Local Meramec River flood control benefits creditable to the considered reservoirs functioning as a system are shown in TABLE R-7. These benefits were allocated to each reservoir by deriving frequency-discharge curves showing the discharge reduction attributed to each individual upstream reservoir acting alone. The system benefits in each reach were thence allocated to each reservoir in the proportion that its average annual discharge reduction was of the sum of the average annual discharge reductions provided by all reservoirs affecting the reach. Mississippi River flood control benefits were allocated to the reservoirs in accordance with the procedure described in subparagraph e above. No Mississippi River benefits were assigned to reservoirs providing a frequency of protection less than once in 100 years. Total flood control benefits allocated to each reservoir are summarized in TABLE R-7 and amount to \$2,387,100 annually.

7. WATER QUALITY BENEFITS

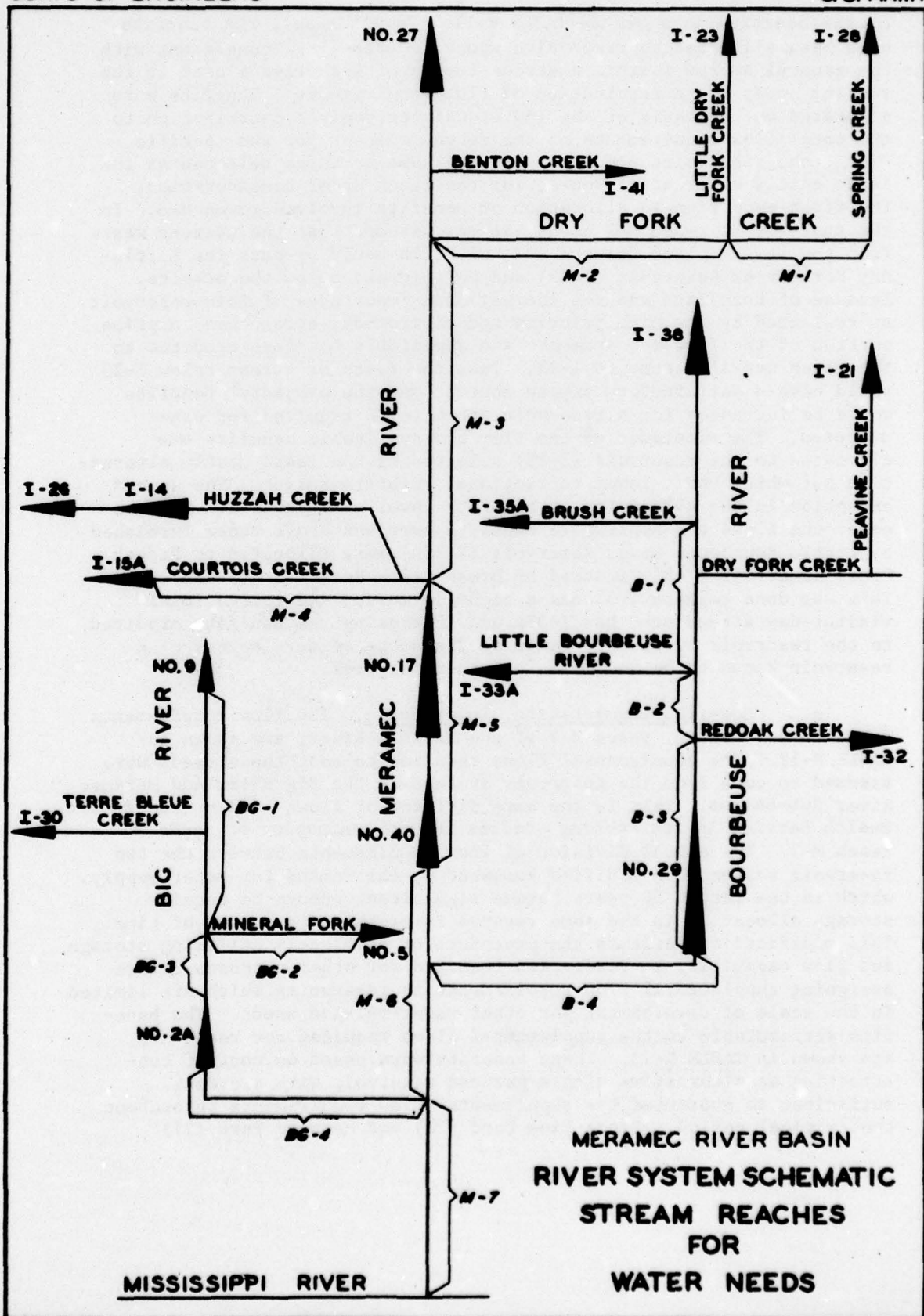
a. General. Water quality control benefits include the value of low-flow augmentation in the downstream reaches and the ponding effects that the reservoirs have in reducing the low-flow requirements. For purposes of evaluation, the needs for low-flow augmentation were divided into two parts: the flow requirements for reach M-7, lower Meramec Basin area; the flow requirements for the reaches of stream in the upper basin area of the three sub-basins. The value of these needs was based on the cost of a single-purpose reservoir required to provide the storage needed to supplement the reaches' base flows in accordance with Public Health Service specified flow requirements. In order to facilitate the economic evaluation for the storage required without the necessity of developing mass curves of runoff at each of the sites, curves of releases versus deficiency in flow were developed for each of the principal gaging stations of the three sub-basins. This was accomplished by development of a program for use with electronic computer. Using the stream flow records at Eureka on the Meramec River as an example, the following procedure was used. First, various base flow rates expressed in c.f.s. per square mile were established covering a sufficient range of points to permit development of a reliable curve. The computer program then changed all actual observed daily flows for the period of record into c.f.s. per square mile values. A process of scanning then took place whereby the computer compared each observed daily flow to the desired flow per purpose, and, when the actual flow was less than that desired, the "deficiency" in flow was computed. This process continued and accumulated the daily deficiencies. When the actual flow became greater than the desired flow, the "excess" was subtracted from the accumulation until it was reduced once again to 0 (zero). When the entire period of record had been scanned, the period of maximum deficiency was used as a point on the curve. This same procedure was repeated using the number of different desired flows and similar points for the curve were developed from

these computed values. A curve of flows versus a deficiency of flows (for the most critical low-flow period) was developed for each of the principal gaging stations. Since both values were expressed in units of c.f.s. per square mile, and based on the assumption that yields from ungaged areas are proportional to that from gaged areas at a downstream point by the ratio of drainage areas, it is possible to go to the proper curve with any flow requirement at any reservoir site and determine the flow deficiency at that point. The flow deficiency is a storage that would be required at the reservoir site to provide the desired release through the critical period of record. To this was added the losses due to evaporation for the same critical period and required sedimentation pool. To be conservative, the rate of need established by the Public Health Service was spaced in time using construction increments (25 years) which a prudent user would be likely to adopt. Cost of these single-purpose reservoirs was based on Federal interest rate of 3 percent properly discounted to present worth.

b. Low-flow augmentation, upper basin. The Public Health Service analyzed the low-flow requirements for individual stream reaches in each of the three sub-basins. The river reaches and location of the main stream and tributary stream reservoirs are schematically shown on FIGURE 1, RIVER SYSTEM SCHEMATIC - STREAM REACHES FOR WATER NEEDS. The flow requirements for the stream reaches in the upper basin are shown in TABLE R-8. These needs include both the base and supplemental flows required to maintain a satisfactory oxygen content and were based on an analysis of the potential economic development of the basin. The value of the supplemental flows is shown in TABLE R-9 and is based on construction of a single-purpose reservoir with storage sufficient to guarantee the supplemental flow requirements throughout the critical period and the annual operation and maintenance costs. To be conservative, the construction value of the latter three increments of demand was based on the difference in cost for constructing the base alternate development with storage needed to meet the first 25-year demand increment and the cost of the same reservoir with sufficient storage to meet the total accumulative flow requirements for the time period involved. The storage indicated is the total storage required and includes a base amount for the supplemental flow required, as well as an allowance for both the evaporation losses during the critical period and sediment storage. The reservoir used as the measure of the least costly alternative for the reach involved is indicated as the controlling reservoir, and the applicable project cost includes charges for lands and damages, relocations, minimum reservoir clearing, dam structure, access roads, engineering and design costs, and supervision and administration costs. The benefits creditable to the supplemental flows for each reach are shown in TABLE R-10 and are based on the value of the flows converted to an equivalent uniform annual value over the 100-year period of analysis and discounted to reflect the time differential between time of need and the economic base year. Net average annual benefits are estimated to be \$1,308,000. Allocation

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of the benefits is shown in TABLE R-11. In all cases, the benefits have been allocated to reservoirs whose locations are consistent with the general source (within a stream reach) of withdrawals used in the routing study for determination of flow requirements. Benefits were allocated on the basis of the individual reservoir's contribution to the total flow requirements of the reach. Except for two specific cases, the reservoirs credited were the same as those selected as the least costly alternative source for the reach under consideration. The first exception in allocation of benefits involved reach M-3. In the analysis of reach M-3 needs, it was assumed that the treated waste from the sewage plant for the city of Rolla would by-pass the Little Dry Fork Creek Reservoir (I-23) and be released below the damsite. Because of this fact and the recreational importance of this reservoir as reflected by its high priority and visitor-day attendance, a prime portion of the flow requirements and applicable benefits credited to the reach was allocated to I-23. Thus the reach of stream below I-23 would have a satisfactory oxygen content and the projects' benefits would be increased for a reservoir known to be required for other purposes. The remainder of the flow and applicable benefits was allocated to the reservoir (I-28) selected as the least costly alternative but which had a lower recreational priority rating. The second exception in the allocation of benefits involved reach B-2. In this case, the flows and applicable benefits over and above those furnished by Little Bourbeuse River Reservoir (I-33A) were allocated to Redoak Creek Reservoir (I-32) instead of Brush Creek Reservoir (I-35A). This was done because I-32 has a higher priority and recreational visitor-day attendance than I-35A and increasing the benefits credited to the reservoir would help maximize the scope of development of a reservoir known to be required for other purposes.

c. Low-flow augmentation, lower basin. The flow requirements for the lower basin, reach M-7 of the Meramec River, are shown in TABLE R-12. The supplemental flows required to meet these needs were assumed to come from the reservoir systems in the Big River and Meramec River Sub-basins. This is the same division of flows used by the Public Health Service in its routing studies for determination of needs in reach M-7. The actual division of flow requirements between the two reservoir systems was modified somewhat by the demand for water supply, which in the latter 50 years became significant enough to require storage allocation in the same reservoir for the same period of time. This modification reflects the procedure of completely utilizing storage and flow capability in reservoirs required for other purposes before assigning supplemental flow requirements to reservoirs which are limited in the scale of development for other water-related needs. The benefits attributable to the supplemental flows required for reach M-7 are shown in TABLE R-13. These benefits were based on cost of constructing an alternative single-purpose reservoir with storage sufficient to guarantee the supplemental flow requirements throughout the critical period. Since Pine Ford (2A) and Meramec Park (17)

Reservoirs have a total storage sufficient to meet the flow requirements from each sub-basin and the lowest unit cost of construction per acre-foot of storage, they were used as the measure of the least costly alternative of meeting the needs from the Big River and Meramec River systems, respectively. Based on the flow requirements, the storage required to guarantee the supplemental needs to the base flow was determined. The value of these flows was equivalent to the cost of constructing and maintaining a base reservoir development with storage needed to meet the first 25-year demand plus the incremental cost difference between the base development and the same reservoir constructed with sufficient storage to meet the total accumulative flow requirements for time period involved. The benefits creditable to reservoir releases were computed as equal to the value of the supplemental flows, converted to an equivalent uniform annual value and discounted to reflect the time differential between year of need and the economic base year. The resultant net average annual benefit for low-flow augmentation in the lower basin area is \$1,034,300. Prior to allocation of the water quality benefits in reach M-7, the supplemental flow capability of the main stream and tributary stream reservoirs was established. The supplemental flow capability of each reservoir for its local or downstream reach was determined from available storage in the net joint-use pool and the applicable critical period. The supplemental flow capability in reach M-7 for all reservoirs located upstream of Pine Ford Reservoir (2A) on the Big River, Meramec Park Reservoir (17) on the Meramec River, and Union Reservoir (29) on the Bourbeuse River was computed as follows:

- (1) A mass flow curve during the critical period was constructed for each of the three main stream gaging stations on a c.f.s. per square mile basis.
- (2) The average daily flow at each reservoir site during the critical period was then determined by use of the computed c.f.s. per square mile factor and prorated in relation to the individual drainage area controlled.
- (3) The net capability of the upstream reservoir for reach M-7 was then equal to the difference between the total regulated outflow of the upstream reservoir and the natural base flow, adjusted by the difference in critical periods for the upstream reservoir and lower main stream reservoir.

The results of this flow capability analysis are presented in TABLE R-14. Based on this information, the benefits creditable to supplemental flows for water quality in the lower basin were allocated to selected reservoirs. Since only three reservoirs were capable of supplementing reach M-7 flows, benefits credited to the Big River were allocated to each reservoir in relation to the amount of net joint-use storage available. Selection of reservoirs in the Meramec

River Sub-basin was confined to specific ones in an attempt to maximize the scale of development wherever possible. Allocation of benefits credited to the Meramec River system was prorated to each reservoir on the basis of its contribution to the system requirements. The reservoirs selected and benefits credited for supplemental flows are shown in TABLE R-15.

d. Ponding benefits. As part of its evaluation of the basin's needs for low-flow augmentation in the interest of water quality control, the Public Health Service studied flow requirements in all reaches of the main stream and principal tributaries in the three sub-basins. Routings were made for future conditions with and without the reservoirs in place. The results of these two routings, expressed in flow requirements for the indicated reaches of each sub-basin, are shown in TABLE R-16. Depending upon the location of "load centers", flow requirements for certain reaches were decreased with the reservoirs in place. This decrease in flow requirements, shown in TABLE R-16, is due to a "ponding effect" created by specific reservoirs in that the reservoirs serve the same function that a lagoon does in providing a tertiary degree of treatment. Since the geographic location of a reservoir modifies the amount of flow required, the net value of storage for water quality control is equal to the value of the storage necessary to provide the smaller supplemental flow requirements plus the incremental worth of the flow reduction. Based on information contained in TABLE R-16, demand curves were constructed for each reach based on future conditions with and without reservoirs in place and the difference in flow requirements determined on 25-year incremental time periods. Part of the value of this flow reduction was then determined, based on the difference in construction costs of a single-purpose reservoir needed to provide the necessary supplemental storage for each flow requirement per time period. The results of this evaluation are presented in TABLE R-17. Shown for each time period are the difference in flow requirements in terms of c.f.s. and supplemental acre-foot storage and the net difference in construction cost between the two single-purpose reservoirs. The benefits creditable to the reservoir are shown in TABLE R-18 and are based on the summation of the incremental values for the difference in construction and annual maintenance costs applicable to the flow reduction converted to an equivalent uniform annual value and discounted to reflect the time differential between time of need and the economic base year. Total average annual benefits attributable to ponding are estimated at \$71,000.

e. Total water quality control benefits. Based on the foregoing, a summary of the average annual benefits credited to each of the reservoirs for water quality control is shown in TABLE R-19. Total average annual benefits for water quality control for the basin as a whole are equal to \$2,413,300.

8. WATER SUPPLY

The Public Health Service, in its evaluation of future municipal and industrial water supply requirements, determined that during the study period the need would occur only in the lower basin area. The flow requirements are shown in TABLE R-20. The values of the supplemental flows are shown in TABLE R-21 and are based on the least costly alternative of securing the supplemental flows, in this case, pumping water from the Missouri River to the service area involved. Cost of this alternative includes the cost of constructing the required pumping and intermediate standpipe facilities and the construction cost of the pipelines required to transport the water. The cost of the pumping facilities and standpipe storage, as well as the annual operation and maintenance costs, was determined by the Public Health Service on the basis of unit cost per required m.g.d. The construction cost of pipeline in place was based on information and unit prices obtained from the Distribution Section, Water Division, city of St. Louis. In establishing unit prices for pipelines, it was assumed that: (1) Due to the rapid growth being experienced in the county, land between the pumping plant and the service area would be highly urbanized at the time of need. Consequently, pipelines would be laid within existing dedicated street right-of-way and no costs would be charged for this item. (2) Based on the above, unit cost of construction would have to reflect a construction cost penalty; i.e., increased cost due to slower progress and additional work items, such as working around existing utilities now in place. Derivation of the benefits creditable to the supplemental flows is shown in TABLE R-22 and is based on the value of the flows converted to an equivalent uniform annual value over the 100-year period of analysis and discounted to reflect the time differential between time of need and the economic base year. Conversion of construction costs to an annual value was computed at a 5-1/2 percent interest rate with a repayment period of 25 years to reflect that part of the cost element which would actually be incurred in the undertaking of the alternative measure, but discounted at the applicable Federal interest rate of 3 percent in accordance with guidelines established by Senate Document No. 97,

87th Congress. Total net average annual benefit for water supply is estimated to be \$1,085,700. Before the water supply benefits could be allocated, the remaining supplemental flow capability (total less requirements for other purposes) available in each main stream and tributary stream reservoir was established. The supplemental flow capabilities available for water supply are shown in TABLE R-23. Based on this information, water supply benefits were allocated to the individual reservoirs on the basis of their ability to contribute to flow requirements in the lower basin area (reach M-7). Allocation of benefits credited for supplemental water supply is shown in TABLE R-24.

9. RECREATION

Annual visitor-day attendance for general recreation only was estimated by the Bureau of Outdoor Recreation and the National Park Service. The total visitor-day attendance was related to demands generated by the population within the zone of influence as of 1970. Visitor-day attendance for each reservoir was related to the total development cost of the recreational facilities contemplated at the reservoir and the distance from the population centers. For purposes of this report, estimates of recreational attendance and development costs were based on a normal pool equal to the reservoir's total storage less storage required for a specified degree of flood protection - standard project flood in the main stream reservoirs and floods having a frequency of occurrence of once in 50 years in the tributary stream and headwater reservoirs. Subsequent economic analysis and storage allocation for project formulation, as contained in the MAIN REPORT, VOLUME I, either maintained the same normal pool level or increased it. To be conservative, no reanalysis of attendance was undertaken since the two prime factors of allocation, development costs and distance to population centers, would still have the same relative control. Furthermore, the attendance estimates are the expected initial visitation for 1970 only. Actual visitation, including anticipated growth and ultimate attendance, will be fully developed once the reservoir is in operation and has been in use for a while. The total average annual benefits for general recreation at each of the 31 reservoirs are shown in TABLE R-25. The total development costs and creditable annual visitor-day attendance estimated for each reservoir by the Bureau of Outdoor Recreation and the National Park Service are shown in columns (1) and (2), respectively. Based on the value per visitor-day, column (3), as established by the Bureau of Outdoor Recreation, the total general recreation benefits for each reservoir were determined and are shown in column (4). Development costs reflect those to be borne by the Federal Government, the State of Missouri, and other groups, including local government as well as private enterprise. After discussions with various State and local agencies, and based on recreational development experienced at other Corps of Engineers' reservoirs, a division of recreational responsibility on a percentage basis was established for each reservoir. The degrees of responsibility assigned

are shown in columns (5), (6), and (7). Once the division of recreational responsibility was known, the division of development costs and creditable annual visitor-day attendance was determined and is shown in columns (8) through (11) and (12) through (14), respectively. These costs were then analyzed to insure that the shares suggested for non-Federal interests were not so great as to be impossible of achievement. The Corps of Engineers' development costs were also analyzed and adjusted where necessary to insure that the costs were adequate to provide the minimum basic facilities for the expected recreational attendance. This minimum development cost is dependent upon the type of recreational usage anticipated and was used for those reservoirs where the Federal Government's share of the annual visitor-day attendance was 53,000 or less. The criteria of 53,000 annual visitor-day attendance were found to be the saturation load for the facilities and lands provided as the minimum basic unit for the anticipated use patterns. The adjusted costs for recreational facilities are shown in column (9). The division of benefits creditable to the Federal and non-Federal interests was based on the total benefits creditable to each reservoir prorated in accordance with the degree of responsibility assigned. For the purposes of this report, only the benefits credited to the facilities to be built and operated by the Corps of Engineers were used in the project formulation. These average annual benefits total an estimated \$6,860,600.

10. FISH AND WILDLIFE

a. General. Fish and wildlife benefits are based on the value of the fisherman-day and hunterman-day attendance at the reservoirs and reaches of stream below the reservoirs. For purposes of project formulation, the evaluation of benefits was divided into three parts - benefits creditable to fisherman-day use at the reservoirs, benefits creditable to fisherman-day use for the reaches of stream below the reservoirs, and benefits creditable to the hunterman-day use in the area surrounding the reservoir and downstream reach of stream. All estimates of attendance and the unit values used to determine the worth of the attendance were furnished by the U. S. Fish and Wildlife Service. The unit values are composite net worth figures that reflect the average worth of a range of values for anticipated classes or types of fishing and hunting expected to be encountered in the individual reservoir or stream area. Derivation of the unit values was based on the Interim Schedule of Values for Recreational Aspects of Fish and Wildlife as adopted by the Inter-Agency Committee on Water Resources.

b. Fishing benefits, reservoir area. Derivation of the total net average annual benefits creditable to the fisherman-day use attendance at the 31 reservoirs is shown in TABLE R-26. Estimates of fisherman-day use for the reservoir area without the project and with the project in place are shown in columns (1) and (2), respectively. The estimated annual net gain in fisherman-day use of the proposed reservoirs

is shown in column (3). Based on the unit value shown in column (4) for the classes of fishery anticipated to develop at these reservoirs, total average annual benefits equal to \$1,986,400 were determined by multiplying the net gain in fisherman-day use by the unit value.

c. Fishing benefits, stream area. Derivation of the total net average annual benefits of \$139,600 creditable to fisherman-day use attendance for reaches of stream below the reservoirs is shown in TABLE R-27 (upper basin) and TABLE R-28 (lower basin). These benefits, resulting from supplemental flows provided by the reservoirs, reflect improved habitat for fishing. These benefits are based on the estimated annual net gain in fisherman-day use for the stream reaches and the unit worth of the attendance. Benefits were allocated to the reservoirs on the basis of their contribution to the flow requirements.

d. Hunting benefits. Derivation of the total net average annual benefits of \$28,700 creditable to the hunterman-day use attendance for the reservoir area and reach of stream below is shown in TABLE R-29. The benefits result from the hunting opportunities afforded by the reservoirs' controlled land management programs and the effects that flood control will have on the development of flood plain acreage below the reservoirs. These benefits are based on the estimated annual net gain in hunter use and the unit worth of the attendance.

e. Summary of recreation benefits. A summary of the fish and wildlife benefits totaling \$2,154,700 and creditable to the 31 reservoirs is shown in TABLE R-30. A summary of the total recreational benefits equal to \$9,015,300 for all 31 reservoirs, including general recreation, as well as fishing and hunting, is shown in TABLE R-31.

11. MISSISSIPPI RIVER NAVIGATION

Routing of reservoir releases for water needs in the lower Meramec Basin (reach M-7) indicates that these supplemental flows will augment low-flow deficiencies on the Mississippi River in the interest of navigation. The value of these low-flow augmentation effects was determined and published as part of a report, "Mississippi River Reservoir Benefit Study", prepared by the Mississippi River Commission, Corps of Engineers, U. S. Army, Vicksburg, Mississippi. Distribution of low-water benefits was divided among the tributary streams in proportion to the reservoir effects on the Mississippi during the applicable critical low-water period. Average annual benefits allocated to the system of reservoirs in the Meramec Basin amounted to \$194,000 and were credited to 615,000 acre-feet of storage dedicated for use in augmenting low flows in the middle and lower Mississippi River. By use of indices, the value of \$194,000 (1958 price level) has now been increased to \$231,000. Based on the revised value (\$231,000) and the applicable storage (615,000 acre-feet), a unit value of \$0.3756 per acre-foot of storage was determined as the net

worth of the incidental effects that supplemental flows in reach M-7 will have in augmenting low flows on the Mississippi River. The benefits creditable to the supplemental flows are shown in TABLE R-32. Item 1, "Storage required for downstream releases", has been divided into 25-year periods to show the successive increments of reservoir capacity needed to provide the reach M-7 flow requirements. These flow requirements were summated in relation to demand until such time as the releases, in terms of storage required, were equal to the 615,000 acre-feet of storage credited the Meramec Basin. Item 2, "Value of storage", was computed by multiplying the unit value of storage worth, \$0.3756 per acre-foot, by the storage available for downstream releases. Then the value of successive increments of reservoir capacity (Item 3) was determined and the total net benefits established (Item 4), discounted to the economic base year. Allocation of the navigation benefits is shown in TABLE R-33 and was based on the percent proportion of the storage provided in the individual reservoir to the total storage requirements for each successive time increment. The number of reservoirs credited was limited by time and the demand in reach M-7. Up to the year 2045, when the sum of storage provided equaled the storage credited the basin, the demand in reach M-7 had not been so great as to require supplemental flow releases from other upstream reservoirs.

SECTION III - AREA REORIENTATION BENEFITS

12. NATURE OF REDEVELOPMENT BENEFITS

In addition to the primary benefits credited to the project for products and services normally derived from a development of this nature, the proposed reservoirs have been credited with additional benefits based on contributions to the reorientation of the depressed economy of the upper basin. These benefits are of two basic types - those benefits derived from the relief of unemployment during the construction period and operation and maintenance of the project, and the benefits derived from new economic activities and developments from the broadened and reorientated economic base starting when the project becomes operational and continuing indefinitely. The bases for the evaluation of these benefits are explained in the following paragraphs.

13. BENEFITS ATTRIBUTABLE TO THE RELIEF OF UNEMPLOYMENT

a. General. A large portion of the upper basin is suffering substantial and persistent unemployment, causing hardship to thousands of individuals and their families. Franklin, Washington, Dent, Iron, Reynolds, St. Francois, and Ste. Genevieve Counties, parts or all of which are located in the basin, have been designated as areas eligible for assistance under the Area Redevelopment Act of 1 May 1961. Senate Document No. 97, 87th Congress, 2d Session, provides that in areas so designated, project benefits shall include the value of the labor and other resources required for project construction and expected to be used in project operation, maintenance, and added area employment during the life of the project to the extent that such labor and other resources would, in the absence of the project, be unutilized or under-utilized.

b. Benefits creditable to reservoir construction. The first type of benefit that will accrue to the upper basin will be the savings in unemployment compensation during construction, which represents a short-range economic activity creditable to the reservoir. These benefits were credited only to those reservoirs that were located in counties designated for assistance under the Area Redevelopment Act and are equivalent to the value of wages paid for the use of unskilled labor. Examination of reservoir construction records for projects currently being undertaken by the St. Louis District shows that approximately 40 percent of the construction cost is for labor and that approximately 50 percent of the labor cost is equal to the wages paid unskilled and, in some instances, semi-skilled labor available for hiring in these areas. Consequently, 20 percent of the construction cost was used to compute the applicable wage component for labor that would be employed and taken off the area relief roles. The value of the wage component was then determined as equal to the wage component plus the applicable interest on the investment during the construction period. Interest during construction was computed by multiplying the current Federal interest rate

of 3 percent by one-half of the estimated construction period times the total estimated wage component. The average annual benefits creditable to the reservoirs located in the designated counties are estimated at \$641,600. Derivation of these benefits is shown in TABLE R-34 and is based on the value of the wage component converted to an equivalent uniform annual value by use of an interest rate of 3 percent and amortization period of 100 years.

c. Benefits creditable to reservoir operation. The second type of benefit attributable to the reservoirs reflects the use of local labor for the operation and maintenance of the project features after construction. Creditable only to those reservoirs located in counties designated for assistance under the Area Redevelopment Act, this additional savings in unemployment compensation represents a somewhat longer range economic activity that will create permanent jobs for the presently unemployed. Operational costs for those reservoirs in the designated depressed areas were analyzed to determine the jobs that would be available for the unskilled. This applies to manpower required for specific features, such as recreational facilities and maintenance of project lands. In all cases, credit was claimed only for those jobs where local personnel would be used as allowed under existing Civil Service regulations and hiring practices. Once the local labor cost was determined, the value of the labor component was computed. To be conservative, it was assumed that these areas will not remain in an economically depressed state for long after completion of the project. Therefore, a development period not to exceed 10 years was assumed for the determination of the labor component value, with the value decreasing each year during the 10-year period. Thus, the value of the labor component was computed as equal to the sum of the local labor costs during the 10-year period, decreasing in worth each year and discounted at the Federal rate to present worth. Derivation of average annual benefits of \$135,300 creditable to the reservoirs located in the designated counties is shown in TABLE R-35 and is based on the value of the wage component converted to an equivalent annual value. The interest rate used was 3 percent with an amortization period of 100 years.

14. BENEFITS ATTRIBUTABLE TO LOCAL ECONOMIC DEVELOPMENT

a. General. The proposed reservoirs will provide benefits based on their contribution to the permanent constructive reorientation of the depressed economy of the upper basin. Construction of reservoirs where there were no reservoirs before has introduced a new and important factor, namely, water-based recreation, into the economy of many areas in the United States. Its economic consequences have become so important to the people in the surrounding communities that the Outdoor Recreation Resources Review Commission (ORRRC), in its report to the President and to the Congress, published a separate study report No. 24, entitled "Economic Studies of Outdoor Recreation". The importance of recreation as a business that will contribute to the creation of more jobs and

raise income levels of an area has also been stressed by the U. S. Department of Commerce, Office of Area Development, in its pamphlet "Your Community Can Profit From the Tourist Business", Recreation itself has become a major water purpose in basin planning and has been recognized by local interests in formulation of their Over-all Economic Development Program, prepared to secure assistance under the Area Redevelopment Act. This long-range benefit will accrue to the counties in the upper Meramec Basin from water- and land-based recreation and associated activities and has been evaluated. This benefit has been divided into two parts: the wages that would accrue to the local economy from the money spent by the recreationists at the reservoir; and the value of recreation business as a stimulus to the total local economy in terms of new jobs and special services. The bases for the evaluation of these benefits are given in the following subparagraphs.

b. Evaluation of wages accruing from tourist expenditures. To determine the wages that would accrue to the local economy from the money spent by the recreationists at the reservoirs, information and study data contained in the paper entitled "Private and Public Provision of Outdoor Recreation Opportunity", printed in the ORRRC study report No. 24, were used. The paper contained estimated expenditure per person per day for visitors to specified kinds of public recreational areas. For the purposes of this report, the breakdown of costs for visitors using Federal reservoirs built by the Corps of Engineers and Tennessee Valley Authority was used. Of the total estimated daily cost of \$9.75 (1960 price level), this report used only the cash outlay made during or immediately preceding the visit for food, lodging, transportation, and miscellaneous items equal to \$5.25. Reasonable charges for use of equipment, such as auto, boats, etc., equal to \$4.50 were deleted from consideration. The probable location of these expenditures was shown to vary greatly according to the type of area visited. For the purposes of this report, only that percent of the monetary outlay spent in or near the project area was used. Thus it was found that only \$2.11 out of the \$5.25 expended by the tourist was spent in or near the reservoir. Once the expenditure by the tourist in the general area was known, a division of the money spent according to the operational requirements of the recipient was determined. From this breakdown of costs incurred by the business operators, it was found that only \$0.515 of the \$2.11 spent was for the payment of wages for hired labor. These data are summarized in TABLE R-36. Based on the foregoing information and on the visitor-day attendance at each reservoir, the accruable wages in the form of average annual benefits, amounting to \$2,214,200 and creditable to all reservoirs were determined. Results of this determination are shown in TABLE R-37.

c. Evaluation of local economic impact. A paper entitled "Reservoir Recreation and Local Economic Growth", contained in the referenced ORRRC study report No. 24, analyzed the effects that reservoirs have on an area's economic structure, particularly in areas in which large bodies of water were relatively unavailable before the coming of

man-made reservoirs. This approach made the effects of recreation easier to assess than in areas where water recreation has long been established. One of the paper's studied regions that is comparable to the Meramec River Basin is the Arkansas-Missouri-Ozark area on the White River. The projects involved in this study were the Norfolk, Bull Shoals, and Table Rock Reservoirs, all constructed by the Corps of Engineers. It should be pointed out that this particular area includes one privately constructed reservoir, Lake Taneycomo, where the recreation industry has been established for some 30 years; is within 50 miles of a large Missouri State park; and services some of the population centers from which the Meramec Basin reservoirs would draw. Thus, the growth factors applicable to this study area would tend to be conservative when applied to the Meramec Basin. It also should be noted that the study area's main economic base was agricultural and is similar to the rural areas in the upper basin of the Meramec, although the yields and value of farmland in the Meramec Basin are generally much higher. Most of the counties in the study area were at a lower economic level than the average for the State and nation before the reservoirs were constructed. However, the study showed that the reservoirs with their accompanying recreational aspects have created a marked increase in economic activity and a rise in living standards. Allied factors contributing to the importance of recreation in the Meramec Basin are the decrease in the number of jobs available in the field of agriculture, the scarcity of alternative economic opportunities in the upper basin, absence of natural lakes, an attractive average summer temperature, and the abundance of woodlands suitable for recreation. Today the main problem of the upper Meramec Basin is really the lack of opportunity for capital to be profitably employed. The reservoir projects will act as catalysts for the process of attracting outside dollars to the areas and putting them to work in an economically productive manner. The necessary capital for the most part comes from outside the local communities in the area and thus starts the process of growth which local leaders of the basin have so long sought. The economic impact of a new reservoir makes itself felt locally in five phases:

(1) Land speculation. Once the reservoir is constructed and in operation, land values become greatly enhanced. This enhancement reflects the demand for acreage that could be used for both business and residential developments.

(2) Construction. Once the reservoir is in operation, construction of new developments attracted to the reservoir area induces a new payroll. The recipients in turn will respond what they get for needs that are serviced by the communities and local established businesses.

(3) Recreation. Growth of the recreational business in terms other than jobs but in terms of goods and services purchased in the local area and the profit margin secured by the business operator are all stimuli to the local economy caused by outside money.

(4) Shift in economic structure of nearby towns. Once the reservoirs are in operation, the nearby towns begin to undergo a basic shift in economic structure, changing from one that is essentially a single-based economy devoted to serving small farms with low income to one that is diversified and provides the needs of visitors that expect services and goods equal to urban standards. Local towns and existing business start needed improvements and new enterprises arrive and add to the revised economic structure.

(5) Homesite development and construction. Once the reservoirs are in and a pattern of recreational visitation is established, newcomers, individuals or real estate developers, begin to build homes and subdivisions around the lake. Real estate and local construction industries boom. Today most of the homes are not just the vacation-cabin type, but usually will be built for year-round use, often by families who continue to live in nearby cities and who want a place of their own in or around a particular lake. Too, an increasing number of homes are being built for retired or semi-retired couples who move to the area for permanent residence. An example in the State of Missouri is the town of Branson near Bull Shoals, Table Rock, and Norfolk Reservoirs complex on the White River.

The basic unit used to measure the rate of economic growth was the county for the practical reason that economic statistics were obtainable. While the economic impact does not extend uniformly over the county as a whole, the use of statistics for the county will tend to understate the actual effects of recreation on the towns and areas closest to the reservoirs. The choice of counties used in the study followed from the location of the reservoirs. Five different indices were established to reflect the degree of growth: population, per capita income, annual wages, retail trade, and bank deposits. For the purposes of this report, the changes reflected by bank deposits were used to determine the economic growth that could be anticipated in the Meramec Basin. This indicator was used because, more than any other, it seemed to reflect the inflow and the resultant effects that outside capital, both personal and business, would have on the local economic structure. As was done in the ORRRC study, the deposit figures for the counties involved excluded Government as well as inter-bank deposits. This was done to avoid any possible temporary expansion due to Government activities. Based on the study of those counties in the Arkansas-Missouri-Ozark area on the White River, an average annual growth figure of 4.5 percent was found to have occurred. This growth figure was based on the difference between the rate of growth for those counties having major shorelines and recreational facilities and which received their chief stimulus from recreation in the periods under review and the rate of growth for those counties that did not have any reservoirs but were adjacent to counties which had one or more reservoirs. In determining the value of economic growth and development pattern, it was felt that development due to the reservoirs themselves should be limited by a time factor and that at some point in time this economic development would start a second round of spending and expenditures that would not be strictly applicable to the reservoirs and somewhat secondary in nature. Consequently, to be

conservative, a time limit of 20 years was assumed within which time following the construction of these reservoirs, the primary economic impact due to local growth would be reached. This allows a period of some 3 years for the recreation visitation pattern to be established and 17 years for the creditable economic growth to be obtained. The facts that all the reservoirs are concentrated in the upper portion of the basin and that the reservoirs under consideration are generally within 15 to 25 miles of each other lead to the conclusion that the economic development accruable should be considered on an area-wide basis (upper basin area) and prorated to the reservoirs based on the visitor-day use creditable to each reservoir. Based on the foregoing, derivation of these average annual benefits estimated at \$1,987,200 is presented in TABLES R-38 and R-39.

d. Total area reorientation benefits. Based on the foregoing, the total average annual benefits attributable to the reservoirs' effects on the upper basin economy are equal to \$4,978,300. The total area reorientation benefits creditable to each reservoir are summated in TABLE R-40.

SECTION IV - NEGATIVE BENEFITS

15. NEGATIVE BENEFITS

Detrimental or negative benefits to overland transportation resulting from costs of providing greater clearances for bridges to be modified or constructed as part of the reservoir projects and increased operation costs of future vehicle operation have been evaluated based upon criteria developed by the Bureau of Public Roads. Since one of the criteria for reservoir selection was that the impoundments should present no major relocation problems, the negative benefits proved to be minor in nature. To determine the increased operation costs to future vehicle operation, the traffic volume for all roads in each of the reservoir areas was established. The latest traffic map of Missouri, prepared by the Missouri State Highway Department, was used to obtain the annual average 24-hour daily traffic on all State controlled and maintained roads. Using this information, a traffic flow map was prepared for each reservoir and the traffic volume estimated for the remaining roads. Once the traffic count was established, a breakdown between passenger and truck traffic was determined based on information received from the Highway Department. Projections of the traffic volume were made for 50 years or the mid-point of the reservoir's economic life (year 2020) to obtain the mean traffic volume that would be affected. Graduated traffic growth rates were used dependent upon the road classification or service provided: 3.5 percent annual rate of growth for main highways, 2.25 percent annual growth rate for all other State highways, and 2.0 percent annual growth rate for the remaining roads. Benefit evaluation was divided into two parts. The first part was based on the increase in vehicular operation costs that result from existing roads being relocated or altered to a higher elevation. This benefit was computed by multiplying the projected traffic volume for passenger cars and trucks by the unit value of increased operation cost per foot of lift for each type of traffic. The second part of the benefit evaluation was based on the increased operation cost that results from the increase in distance traveled on roads whose alignment has been changed. The increased cost was computed by multiplying the projected traffic volume for passengers and trucks by the applicable unit value of cost increase per mile of road change. The negative benefits applicable to the reservoirs are shown in TABLE R-41. No negative benefits were found applicable to the headwater reservoirs. Total average annual negative benefits attributable to the reservoirs are estimated at \$25,900.

16. SUMMARY OF BENEFITS

Summary of the average annual benefits creditable to the 31 reservoirs contained in the basin plan is presented in TABLES R-42 through R-44, inclusive. The total benefits which will be realized from the plan of reservoir operation were used in the allocation of costs to determine the justification of including each purpose served. The total benefits less the negative benefits were used to determine the over-all economic feasibility of each reservoir.

SECTION V - ANGLER-USE SITES

17. ANGLER-USE SITES

The 26 angler-use sites recommended by the U. S. Fish and Wildlife Service for enhancement of stream fishery were considered as independent groups and each group analyzed as a unit. Benefits attributed to these sites depend in part upon low-flow augmentation from upstream reservoirs. The total average annual benefits creditable to the fisherman-day use attendance for each group are shown in TABLE R-45. These benefits, totaling \$251,700, are based on the estimated attendance and unit worth of the attendance as furnished by the U. S. Fish and Wildlife Service. Also shown are the reservoirs that provide the supplemental flows to enhance the stream fishery.

SECTION VI - LOCAL FLOOD PROTECTION PROJECTS

18. GENERAL

It is recognized that the reservoirs are essential to the needs and potential development of the basin as a whole, and that local protection works provided will be incremental to them. Consequently, the reservoir systems have been assigned the initial flood control benefits in the considered levee areas. The analysis of local protection projects reflects the priority given to the construction of the reservoirs, particularly the Union, Meramec Park, and Pine Ford Reservoirs on the lower main streams of each of the three sub-basins. The levee areas were credited with prevention of residual flood damages on land not subject to changed land use, together with benefits due to increased values of land that will be converted to a higher order of use.

19. METHOD OF EVALUATION

It was assumed that bottom land acreage protected by reservoirs would not be subject to residential, commercial, or industrial use unless firm protection is provided by levees. A determination was made of the amount of land currently developed in each considered levee area and that subject to change to a higher order of use. Based on the anticipated pattern of urbanization in the vicinity of lower Meramec River, the time of need or conversion to development was estimated. The difference between the estimated values of land with levee protection provided and with reservoirs in operation but without levees was used as the measure of benefits creditable to the levees for converted land use. Annual values of the benefits were derived by assuming a 5 percent return from the improvements. These annual benefits were discounted at 3 percent to reflect the time lag in attainment in development. In addition, benefits were credited to the levees for the elimination of flood damages in current highly developed areas over and above that which will be prevented by the reservoirs. A summarization of the benefit determination is given in TABLES R-46, R-47, and R-48.

SECTION VII - REEVALUATION OF RESERVOIR BENEFITS

20. REEVALUATION OF RESERVOIR BENEFITS

Based on the benefits contained in the previous sections, the reservoirs were analyzed to determine their overall economic feasibility and the feasibility of each of the purposes served. Of the 31 reservoirs, 25 had a favorable overall benefit-cost ratio; 6 reservoirs, I-14, I-15A, I-21, I-26, I-41, and H-31, had a benefit-cost ratio less than unity. Of the remaining 25, 5 reservoirs, I-23, I-30, I-32, H-10, and H-40, failed to have all of the individual purposes justified. Since one of the criteria in the selection of reservoirs sites was that each site should permit complete development, all 10 of the aforementioned reservoirs, other than I-26, were dropped from further consideration, pending a determination of the remaining 21 reservoirs to meet the immediate and near-future water needs of the basin. The flood control benefits creditable to I-26 were reanalyzed with I-14 out, and the reservoir was found economically justified. To maximize the scope of development for the remaining 21 reservoirs, the residual water quality and water supply needs and benefits previously credited to the above 10 reservoirs were allocated wherever possible, depending upon available storage and location of need. To be conservative, no attempt was made to reallocate recreational and area reorientation benefits. Analyses indicate that only three reservoirs would be affected, I-28, I-33A, and I-35A. The results of the reanalysis, as compared to the original allocation (with 31 reservoirs in place), are shown on TABLE 49. Bases for the change of benefits are shown as applies to each of the four reservoirs.

TABLE R-1
Acreages subject to flooding - present conditions, Meramec River Basin

<u>Damage reach</u>	<u>Crop and pasture</u>		<u>Urban and recreation</u>		<u>Timber and other</u>		<u>Total acres</u>
	<u>Acres</u>	<u>%</u>	<u>Acres</u>	<u>%</u>	<u>Acres</u>	<u>%</u>	
MERAMEC RIVER & TRIBUTARY STREAMS							
1	1,810	39	690	15	2,140	46	4,640
2	7,260	58	1,550	12	3,690	30	12,500
3	6,060	64	240	3	3,100	33	9,400
4	1,330	60	70	3	820	37	2,220
5	2,800	49	140	2	2,810	49	5,750
6	1,910	54	20	0*	1,620	46	3,550
7	450	27	20	1	1,180	72	1,650
8	2,080	42	120	2	2,750	56	4,950
9	1,490	65	50	3	740	32	2,280
10	2,030	60	80	2	1,290	38	3,400
11 (1)	3,680	69	150	3	1,470	28	5,300
Fenton Creek	0	0	50	100	0	0	50
Grand Glaize Creek	0	0	0	0	20	100	20
Calvey-Brady Creeks	810	84	0	0	160	16	970
Indian-Little Indian Creeks	1,140	66	0	0	600	34	1,740
Courtois Creek	1,340	61	10	0*	850	39	2,200
Lost Creek	610	82	0	0	130	18	740
Huzzah Creek	3,540	68	20	0*	1,640	32	5,200
Dry Fork-Spring Creeks	5,810	85	10	0*	980	15	6,800
Little Dry Fork Creek	240	89	0	0	30	11	270
Subtotal	44,390	60	3,220	5	26,020	35	73,630
BIG RIVER AND TRIBUTARY STREAMS							
12	6,180	77	320	4	1,500	19	8,000
13	2,080	71	40	2	800	27	2,920
14	1,460	58	30	2	1,010	40	2,500
15	420	60	20	3	260	37	700
16	1,030	53	30	1	890	46	1,950
17	570	48	10	1	600	51	1,180
18	2,050	45	20	0*	2,530	55	4,600
19	610	65	0	0	330	35	940
20	250	52	0	0	230	48	480
Terre Bleue Creek	700	56	10	1	530	43	1,240
Dry Creek	460	75	0	0	150	25	610
Cabanne Course Creek	20	50	0	0	20	50	40
Mineral Fork-Bates Creeks	1,970	73	10	0*	720	27	2,700
Subtotal	17,800	64	490	2	9,570	34	27,860
BOURBEUSE RIVER & TRIBUTARY STREAMS							
21	700	69	30	3	290	28	1,020
22 (2)	2,930	49	50	1	3,020	50	6,000
23	440	41	0	0	630	59	1,070
24	2,980	55	10	0*	2,460	45	5,450
25	260	54	0	0	220	46	480
26	360	52	0	0	330	48	690
27	800	59	10	1	540	40	1,350
28	530	66	0	0	270	34	800
29	1,010	63	0	0	590	37	1,600
30 (3)	2,480	64	0	0	1,420	36	3,900
Spring-Winsell Creeks	770	71	0	0	310	29	1,080
Boone Creek	870	79	0	0	230	21	1,100
Redoak Creek	220	88	0	0	30	12	250
Little Bourbeuse River	380	84	0	0	70	16	450
Dry Fork-Peavine Creeks	2,340	87	0	0	360	13	2,700
Subtotal	17,070	61	100	0*	10,770	39	27,940
Total	79,260	61	3,810	3	46,360	36	129,430
(Say)	79,300		3,800		46,300		129,400

* Percentages are zero when rounded to the nearest 1 percent.

(1) Acreage on Benton Creek below I-41 Damsite is included in reach 11.

(2) Acreage on Birch Creek below H-6 Damsite is included in reach 22.

(3) Acreage on Brush Creek below I-35A is included in reach 30.

TABLE R-2
Average annual damages - future conditions without improvement
Meramec River Basin

Damage reach	Agric. \$	Urban \$	Farm sets \$	Clubhouses \$	Roads \$	Railroads \$	Bridges \$	Fences \$	Equip. & Livestock \$	Erosion \$	Total \$
MERAMEC RIVER & TRIB. STREAMS											
1	38,200	87,200	1,400	8,300	7,400	13,200	0	3,500	400	400	160,000*
2	125,300	229,800	1,700	19,500	19,000	26,100	600	10,000	1,400	1,400	434,800*
3	121,400	8,600	600	2,700	4,100	5,500	0	9,600	1,100	1,100	164,700
4	23,000	0	600	300	300	0	0	1,900	300	300	26,700
5	58,000	0	500	2,200	1,200	1,900	300	4,600	500	500	69,700
7	0	37,100	0	0	0	0	0	0	0	0	37,100
10	57,600	1,500	500	1,400	1,100	0	100	5,000	400	400	68,000
11	56,200	0	3,400	0	5,300	0	100	5,300	600	600	71,500
Benton Creek	0	38,600	0	0	0	0	0	0	0	0	38,600
Calvey-Brady Creeks	1,300	0	100	0	100	0	0	100	0	0	1,600
Indian-Little Indian Creeks	4,400	0	1,800	0	800	0	900	500	0	200	8,600
Courtois Creek	15,200	0	0	300	1,100	0	0	1,100	0	100	17,800
Lost Creek	17,800	0	1,600	200	800	0	400	1,600	0	200	22,600
Husalah Creek	16,900	0	3,700	200	1,100	0	0	1,300	0	200	23,400
Dry Fork-Spring Creeks	19,600	0	4,000	600	1,100	0	600	1,900	0	400	28,200
Little Dry Fork Creek	144,500	0	3,200	0	1,300	0	1,100	11,000	0	1,500	162,600
Subtotal	3,900	402,800	23,100	35,700	44,800	46,700	4,100	57,800	4,700	7,400	1,340,400
BIG RIVER & TRIB. STREAMS											
12	180,400	1,000	3,100	11,800	6,000	0	600	10,600	1,600	1,200	216,300
13	91,800	0	200	3,900	1,500	0	600	5,000	500	400	103,900
17	4,200	0	300	0	1,400	900	0	600	100	100	7,600
18	23,200	0	0	0	4,700	800	300	2,300	500	400	32,200
20	8,300	0	2,400	0	3,000	0	0	600	100	0	14,400
Terre Bleue Creek	19,800	0	2,400	100	300	0	1,000	1,700	200	200	25,700
Dry Creek	16,700	0	2,700	0	800	0	1,000	1,200	100	100	22,600
Cabanne Course Creek	300	0	200	0	0	0	0	0	0	0	500
Mineral Fork-Bates Creeks	8,400	0	3,800	400	300	0	600	700	100	100	14,400
Subtotal	353,100	1,000	15,100	16,200	18,000	1,700	4,100	22,700	3,200	2,500	437,600
BOURBEUSE RIVER & TRIB. STREAMS											
21	15,500	0	200	300	600	0	0	1,200	0	100	17,900
22	48,900	500	900	3,000	800	3,100	300	3,800	200	500	62,000
26	6,800	0	0	0	200	0	0	600	0	100	7,700
27	17,400	0	300	0	700	0	0	1,300	0	200	19,900
28	13,000	0	300	0	200	0	0	900	0	100	14,500
29	25,700	0	300	0	300	0	0	1,900	100	200	28,400
30	49,500	0	2,100	0	1,400	0	700	3,700	100	400	57,900
Spring-Winsell Creeks	12,000	0	200	0	0	0	0	1,200	0	100	13,500
Boone Creek	11,600	0	2,100	0	400	0	1,000	1,100	0	200	16,400
Redoak Creek	1,700	0	300	0	400	0	600	200	0	100	3,300
Little Bourbeuse River	7,000	0	800	0	200	0	600	700	0	100	9,400
Dry Fork-Peavine Creeks	61,800	0	3,700	0	1,800	0	700	5,400	0	700	74,100
Birch Creek	2,900	0	100	200	0	200	0	200	0	0	3,600
Brush Creek	1,100	0	0	0	0	0	0	100	0	0	1,200
Subtotal	274,900	500	11,200	3,500	7,000	3,300	3,900	22,300	400	2,800	329,800
Total	1,341,300	404,300	49,400	55,400	69,800	51,700	12,100	102,800	8,300	12,700	2,107,800

* Approximately 10,500 acres are subject to flooding by backwater from high Mississippi River stages. Damages chargeable to Mississippi River backwater amount to \$29,400 to crops and \$88,800 to property.

Note: Values shown differ from those indicated in TABLE 15 of the main report due to omission of reaches within reservoir areas.

TABLE R-3
Average annual damages - future conditions with reservoir improvements
Meramec River Basin

Damage reach	Agric. \$	Urban \$	Farm sets \$	Clubhouses \$	Roads \$	Railroads \$	Bridges \$	Fences \$	Equip. & Livestock \$	Erosion \$	Total \$
MERAMEC RIVER & TRIB. STREAMS											
1	15,400	27,800	100	500	2,600	3,500	0	1,800	0	0	51,700
2	39,500	8,900	0	1,000	4,400	3,800	200	2,500	100	100	60,500
3	26,600	0	0	0	600	1,100	0	2,100	0	0	30,400
4	7,700	0	0	0	100	0	0	1,600	0	0	8,400
5	18,300	0	0	0	200	400	0	1,700	0	0	20,600
7	0	0	0	0	0	0	0	0	0	0	0
10	44,700	1,300	500	1,000	900	0	100	4,200	400	400	53,500
11	24,000	0	3,400	0	3,000	0	0	3,000	600	600	34,600
Fenton Creek	0	38,600	0	0	0	0	0	0	0	0	38,600
Benton Creek	400	0	100	0	100	0	0	100	0	0	700
Calvey-Brady Creeks	400	0	0	0	0	0	0	100	0	0	500
Indian-Little Indian Creeks	0	0	0	200	100	0	0	100	0	100	500
Courtois Creek	1,000	0	100	0	100	0	0	300	0	0	1,500
Lost Creek	3,000	0	0	0	200	0	0	300	0	0	3,500
Huzzah Creek	0	0	0	0	0	0	0	0	0	0	0
Dry Fork-Spring Creeks	85,500	0	0	0	900	0	0	7,400	0	0	93,800
Little Dry Fork Creek	3,900	0	0	0	100	0	0	400	0	100	4,500
Subtotal	270,400	76,600	4,200	2,700	13,300	8,800	300	24,600	1,100	1,300	403,300
BIG RIVER & TRIB. STREAMS											
12	41,000	0	0	100	3,600	0	0	3,200	0	0	47,900
13	9,000	0	0	0	200	0	0	700	0	0	9,900
17	1,800	0	100	0	700	400	0	300	0	0	3,300
18	2,900	0	0	0	900	800	300	500	500	400	6,300
20	6,000	0	2,400	0	2,400	0	0	500	100	0	11,400
Terre Bleue Creek	1,600	0	2,200	100	0	0	100	200	200	200	4,600
Dry Creek	400	0	0	0	0	0	0	0	0	0	400
Cabanne Course Creek	300	0	200	0	0	0	0	0	0	0	500
Mineral Fork-Bates Creeks	1,100	0	0	0	0	0	0	300	0	0	1,400
Subtotal	64,100	0	4,900	200	7,800	1,200	400	5,700	800	600	85,700
BOURBEUSE RIVER & TRIB. STREAMS											
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	100	600	100	0	0	0	800
26	6,200	0	0	0	200	0	0	600	0	100	7,100
27	15,200	0	300	0	600	0	0	1,200	0	200	17,500
28	10,500	0	300	0	200	0	0	800	0	100	11,900
29	17,400	0	200	0	200	0	0	1,400	100	200	19,500
30	9,300	0	0	0	300	0	0	900	0	0	10,500
Spring-Winsell Creeks	0	0	0	0	0	0	0	0	0	0	0
Boone Creek	0	0	0	0	0	0	0	0	0	0	0
Redoak Creek	1,700	0	300	0	400	0	600	200	0	100	3,300
Little Bourbeuse River	7,000	0	800	0	200	0	500	700	0	100	9,400
Dry Fork-Peavine Creeks	25,300	0	3,500	0	900	0	600	2,000	0	700	33,000
Birch Creek	2,900	0	100	200	0	200	0	200	0	0	3,600
Brush Creek	1,100	0	0	0	0	0	0	100	0	0	1,200
Subtotal	96,600	0	5,500	200	3,100	800	1,900	8,100	100	1,500	117,800
Total	431,100	76,600	14,600	3,100	24,200	10,800	2,600	38,400	2,000	3,400	606,800

TABLE R-4
Total average annual benefits
Meramec River Basin

<u>Damage reach</u>	<u>Average annual flood damages prevented</u>	<u>Average annual increased return benefits</u>	<u>Total average annual basin benefits</u>
MERAMEC RIVER & TRIBUTARY STREAMS			
1	\$ 108,300	\$ 0	\$ 108,300
2	374,300	56,900	431,200
3	134,300	66,800	201,100
4	18,300	12,200	30,500
5	49,100	28,700	77,800
7	37,100	0	37,100
10	14,500	0	14,500
11	36,900	26,400	63,300
Fenton Creek	0	0	0
Benton Creek	900	600	1,500
Calvey-Brady Creeks	8,100	8,100	16,200
Indian-Little Indian Creeks	17,300	4,800	22,100
Courtois Creek	21,100	8,800	29,900
Lost Creek	19,900	6,400	26,300
Huzzah Creek	28,200	17,900	46,100
Dry Fork-Spring Creeks	68,800	0	68,800
Little Dry Fork Creek	0	0	0
Subtotal	937,100	237,600	1,174,700
BIG RIVER & TRIBUTARY STREAMS			
12	168,400	60,400	228,800
13	94,000	21,600	115,600
17	4,300	4,900	9,200
18	25,900	27,100	53,000
20	3,000	0	3,000
Terre Bleue Creek	21,100	8,100	29,200
Dry Creek	22,200	4,400	26,600
Cabanne Course Creek	0	0	0
Mineral Fork-Bates Creeks	13,000	1,600	14,600
Subtotal	351,900	128,100	480,000
BOURBEUSE RIVER & TRIBUTARY STREAMS			
21	17,900	9,300	27,200
22	61,200	43,100	104,300
26	600	500	1,100
27	2,400	1,300	3,700
28	2,600	1,100	3,700
29	8,900	0	8,900
30	47,400	26,600	74,000
Spring-Winsell Creeks	13,500	4,000	17,500
Boone Creek	16,400	8,300	24,700
Redoak Creek	0	0	0
Little Bourbeuse River	0	0	0
Dry Fork-Peavine Creeks	41,100	0	41,100
Birch Creek	0	0	0
Brush Creek	0	0	0
Subtotal	212,000	94,200	306,200
Total	\$1,501,000	\$459,900	\$1,960,900 ⁽¹⁾

(1) Includes \$91,600 annual benefits in reaches 1 and 2 which are attributable to upper Mississippi and Missouri Rivers "EN" reservoirs.

TABLE R-5
Crop characteristics, damage reach 2 (average 1962 prices)

Future conditions, without improvement						
Crop	Percent distribution	Yield bu/ac	Unit price \$	Total return \$/acre	Production costs \$/acre	Net return \$/acre
Corn	56	130	1.05	136.50	85.92	50.58
Hay	7	5.0(2)	22.00	110.00	54.92	55.08
Wheat	17(1)	65	1.90	123.50	56.55	66.95
Soybeans	20	50	2.30	115.00	43.19	71.81
Lespedeza	17(1)	2.0(2)	22.00	44.00	24.91	19.09
Average per acre						61.17
						28.32
						3.86
						11.38
						14.36
						3.25

Future conditions, with improvement (intensive cropping practices)						
Crop	Percent distribution	Yield bu/ac	Unit price \$	Total return \$/acre	Production costs \$/acre	Net return \$/acre
Corn	56	170	1.05	178.50	111.22	67.28
Hay	7	6.0(2)	22.00	132.00	60.17	71.83
Wheat	17(1)	65	1.90	123.50	56.55	66.95
Soybeans	20	50	2.30	115.00	43.19	71.81
Lespedeza	17(1)	2.5(2)	22.00	55.00	27.31	27.69
Average per acre						73.16
						37.68
						5.03
						11.38
						14.36
						4.71

- (1) Wheat and lespedeza are grown together on the same acreage.
(2) Tons per acre.

TABLE R-6
Evaluation of increased return benefits to cropland
damage reach 2

Future conditions without improvement

Expected income without flooding	
7,260 crop acres (TABLE R-1) x \$61.17 (TABLE R-5)	\$444,100
3,690 timber acres (TABLE R-1) x \$5.00	<u>18,400</u>
Total expected income without flooding	\$462,500
Less crop damages due to flooding (TABLE R-2)	<u>-125,300</u>
Net income received	\$337,200

Future conditions with improvement

Expected income without flooding	
7,630 crop acres (1) x \$73.16 (TABLE R-5)	\$558,200
3,320 timber acres (2) x \$5.00	<u>16,600</u>
Total expected income without flooding	\$574,800
Less cost of timber conversion (3,690-3,320) acres x \$7.63	- 2,800
Less crop damages due to flooding	<u>- 45,700(3)</u>
Net income received	\$526,300
Increase in net income (526,300-\$337,200)	\$189,100
Less crop damages prevented	<u>- 85,800</u>
Increased net return benefits @ 100% participation	\$103,300

$$\text{Percent participation} = \frac{\$85,800 \text{ crop damage prevented}}{\$125,300 \text{ crop damage w/o improvement}} = 68\%$$

Discount factor to reflect a 15-year lag @3.0% over 100 years 81%

Increased net return benefits @ 71% participation and 81% discount factor \$ 56,900

- (1) Converted timberland equals 10% x 3,690 acres = 369 acres.
Total cropland then equals 7,260 + 369 = 7,629 acres (say 7,630)
- (2) Total timberland equals 3,690-369 = 3,321 acres (say 3,320)
- (3) Value determined by the procedure developed by the Office, Chief of Engineers, which is outlined in memorandum ENG CW-E, dated 30 September 1960, subject "Flood Hydrograph - Damage Integration Method of Estimating Flood Damages in Agricultural Areas." Future yields and distributions under conditions with improvement were used.

TABLE R-7
Allocation of total average annual flood control benefits
Meramec River Basin reservoir

<u>Reservoir</u>	<u>Frequency of protection provided (yrs.)</u>	<u>Meramec River Basin benefits</u>	<u>MR&T benefits</u>	<u>Total flood control benefits</u>
#2A	100	\$ 460,500	\$ 91,200	\$ 551,700
#5(1)	-	-	-	-
#9	10	60,900	-	60,900
#17	Std. Proj.	501,500	284,200	785,700
#27	20	74,100	-	74,100
#29	Std. Proj.	308,300	142,400	450,700
#40(1)	-	-	-	-
I-14	50	41,500	-	41,500
I-15A	50	29,900	-	29,900
I-21	50	48,900	-	48,900
I-23(1)	-	-	-	-
I-26	20	4,600	-	4,600
I-28	50	70,300	-	70,300
I-30	10	30,500	-	30,500
I-32(1)	-	-	-	-
I-33A(1)	-	-	-	-
I-35A(1)	-	-	-	-
I-38	50	83,600	-	83,600
I-41	50	3,700	-	3,700
H-3	50	26,600	-	26,600
H-4(1)	-	-	-	-
H-5A	50	16,200	-	16,200
H-6(1)	-	-	-	-
H-8	20	22,100	-	22,100
H-9	50	14,600	-	14,600
H-10A	50	26,300	-	26,300
H-11A	50	17,500	-	17,500
H-13A	50	24,700	-	24,700
H-25	10	3,000	-	3,000
H-31(1)	-	-	-	-
H-40(1)	-	-	-	-
		<u>\$1,869,300⁽²⁾</u>	<u>\$517,800</u>	<u>\$2,387,100</u>

(1) There is no flood control storage provided in this reservoir.

(2) This value does not include \$91,600 annual benefits in reaches 1 and 2 on the Meramec River subject to Mississippi River backwater which have been allocated to upper Mississippi and Missouri Rivers "EN" reservoirs.

TABLE R-8

Water quality (low-flow augmentation)
Upper basin - flow requirements (c.f.s.)*

	1970 (1995 needs)	1995 (2020 needs)	2020 (2045 needs)	2045 (2070 needs)
BIG RIVER SUB-BASIN				
Reach BG-1	43.0	57.0	68.0	80.0
BG-2	-	-	-	-
BG-3	-	-	-	-
BG-4	-	-	-	-
MERAMEC RIVER SUB-BASIN				
Reach M-1	-	-	-	-
M-2	7.5	10.0	12.5	15.0
			2030	2045
M-3**	-	-	17.0	35.0
M-4	-	-	-	-
M-5	-	-	-	-
M-6	-	-	-	-
	Flows required for M-7 (lower basin) satisfy M-6 needs.			
BOURBEUSE RIVER SUB-BASIN				
Reach B-1	3.5	6.0	12.0	21.0
B-2	5.5	13.0	25.0	34.0
B-3	1.0	1.0	1.0	1.0
B-4	16.0	26.0	38.0	53.0

* Rate of need was determined from a demand curve reflecting flow requirements received from the U. S. Public Health Service and spaced in time to reflect construction increments (25 years) which a prudent user would be likely to adopt.

**Flow requirements modified by base flow from Maramec Springs.

TABLE R-9
Water quality (low-flow augmentation)
Upper basin - value of flow requirements (1)

Sub-basin and reach	Controlling Reservoir (2)	1970 (1995 needs)			1995 (2020 needs)			2020 (2045 needs)			2045 (2070 needs)		
		c.f.s.	Storage (ac-ft)	Reservoir cost	c.f.s.	Storage (ac-ft)	Reservoir cost	c.f.s.	Storage (ac-ft)	Reservoir cost	c.f.s.	Storage (ac-ft)	Reservoir cost
BIG RIVER													
Reach BG-1	Irondale (#9) Incremental cost	43.0	19,458	\$7,550,000 7,550,000	57.0	31,431	\$8,055,000 505,000	68.0	46,296	\$8,630,000 575,000	80.0	70,945	\$9,580,000 950,000
MERAMEC RIVER													
Reach M-2	Spring Creek (I-28) Incremental cost	7.5	4,341	2,375,000 2,375,000	10.0	7,608	2,560,000 185,000	12.5	11,250	2,780,000 220,000	15.0	16,064	3,295,000 515,000
M-3	Salem (#27) Incremental cost	-	-	-	-	-	-	17.0	6,769	\$9,070,000 9,070,000	35.0	18,925	\$9,800,000 730,000
BOURBEUSE RIVER													
Reach B-1	Bourbeuse River (I-38) Incremental cost	3.5	4,913	3,480,000 3,480,000	6.0	5,372	3,535,000 55,000	12.0	9,217	3,765,000 230,000	21.0	15,456	4,005,000 240,000
B-2	Little Bourbeuse River (I-33A) Incremental cost	5.5	4,719	3,750,000 3,750,000	13.0	12,155	4,200,000 450,000	13.0	12,155	4,200,000	17.0	19,077	4,470,000 270,000
B-2 Supplement and B-3 (3)	Brush Creek (I-35A) Incremental cost	1.0	3,346	3,550,000 3,550,000	1.0	3,346	3,550,000	13.0	10,430	4,060,000 510,000	18.0	16,400	4,350,000 290,000
B-4	Union (#29) Incremental cost	16.0	12,630	12,500,000 12,500,000	26.0	13,523	12,555,000 55,000	38.0	15,472	12,635,000 80,000	53.0	23,264	12,875,000 240,000

(1) Based on alternative costs of a single-purpose reservoir.

(2) Selection of the reservoir as the most suitable alternative for each reach was coordinated with the U. S. Public Health Service and matches the general source (within a stream reach) of withdrawals used in the routing study for determination of flow requirements.

(3) Flow requirements in the last 50 years exceed the site capability of the alternative reservoir for reach B-2. To be conservative, the needs were combined with the alternate reservoir for reach B-3, which can also serve reach B-2. Storage requirements for the two reservoirs were based on the demand curve for reach B-2 as to time of need, and allocated to the reservoir providing the least increase in construction costs.

TABLE 2-10

* Incremental receivables cost based on data contained in TABLE 8-9. Annual costs and discounting based on Federal interest rate of 3% and amortisation period of 100 years.

TABLE 8-11

[illegible]

TABLE R-12

Water quality (low-flow augmentation)
Lower basin (reach M-7) flow requirements*

	Demand periods			
	1970 (1995 needs) (c.f.s.)	1995 (2020 needs) (c.f.s.)	2020 (2045 needs) (c.f.s.)	2045 (2070 needs) (c.f.s.)
<u>Contributing sub-basin system**</u>				
Big River	105	170	232	299
Meramec River	<u>170</u>	<u>340</u>	<u>554</u>	<u>801</u>
Total reach M-7 demand	275	510	786	1,100

* Rate of need was determined from a demand curve reflecting flow requirements received from the U. S. Public Health Service and spaced in time to reflect construction increments (25 years), which a prudent user would be likely to adopt.

**Division of flow requirements is in accordance with that used by the U. S. Public Health Service in its routing studies for determination of needs.

TABLE R-13
Water quality (low-flow augmentation)
Lower basin (reach M-7) - system benefits (1)

System	Demand period (2)	Flow requirements (c.f.s.) (2)	Equivalent storage (ac-ft) single-purpose reservoir (3)	Incremental reservoir cost	Annual cost		1970 worth of annual costs (5)
					Construction (4)	Incremental O & M	
Big River	1970 (1995 needs)	105	26,554	\$12,600,000	\$398,800	\$25,000	\$ 423,800
	1995 (2020 needs)	170	59,332	1,264,000	40,000	5,000	20,200
	2020 (2045 needs)	232	99,245	1,580,000	50,000	20,000	13,000
	2045 (2070 needs)	299	152,383	2,840,000	89,900	30,000	7,200
							<u>7,200</u>
							\$ 464,200
Big River system benefits							
Meramec River	1970 (1995 needs)	170	20,773	\$14,000,000	\$443,100	\$25,000	\$ 468,100
	1995 (2020 needs)	340	74,987	1,555,000	49,200	10,000	59,200
	2020 (2045 needs)	554	286,173	6,313,000	199,800	30,000	229,800
	2045 (2070 needs)	801	1,059,973	14,044,000	444,500	100,000	544,500
							<u>32,700</u>
							\$ 570,100
Meramec River system benefits							
Grand total		1,100					\$1,034,300

(1) Based on costs required for construction of an alternate single-purpose reservoir with storage sufficient to meet the required flows.

(2) Based on data contained in TABLE R-12.

(3) Storage required to guarantee the supplemental needs to the base flow.

(4) The annual costs for securing the required capital. Computations are based on the Federal interest rate of 3% and amortization period of 100 years.

(5) Total worth of the annual costs, discounted at 3% interest rate to the economic base year.

TABLE R-14
Total supplemental flow capability
Main stream and tributary stream reservoirs

Sub-basin	Reach location	Reservoir	Supplemental flow capability (1)		
			Local (upper basin area)	Reach M-7 (lower basin area)	
BIG RIVER	BG-1	9	97	136	
	BG-1	I-30	7	-	
	BG-2	5	95**	149	
	BG-4	2A	100*	100	
	BG-4	System 2A, 5, 9	385*	385	
MERAMEC RIVER	M-1	I-28	17*	11	
	M-2	I-23	12**	7	
	M-3	I-41	7*	3	
	M-4	27	81	39	
		I-15A	34*	11	
		I-14	31*	10	
		I-26	13	5	
	M-5	17	730*	730	
	M-6	40	153**	153	
	BOURBEUSE RIVER	B-1	I-21	6*	3
		B-2	I-35A	23**	10
I-38			29*	12	
I-33A			20**	14	
B-3		I-32	21**	14	
B-4		29	282*	282	

(1) Based on total drawdown of joint-use pool and encroachment (maximum of 50%) of flood control pool where applicable. Encroachment of flood control pool limited to those reservoirs providing protection against floods having frequency of occurrence of once in 50 years or more and is indicated by *. Reservoirs having no flood control storage indicated by **.

TABLE R-15
Water quality (low-flow augmentation)
Lower basin (reach M-7) - allocation of benefits

<u>Reservoir</u>	<u>Reservoir share of system benefits (percent)</u>	<u>Applicable supplemental flow (c.f.s.)</u>	<u>Reach M-7 benefits</u>
BIG RIVER SYSTEM*			
Pine Ford (2A)	25.88	78	\$ 120,100
Washington Park (5)	38.72	116	179,800
Irondale (9)	<u>35.40</u>	<u>105</u>	<u>164,300</u>
Subtotal	100.00	299	\$ 464,200
MERAMEC RIVER SYSTEM**			
Meramec Park (17)	95.84	622	\$ 546,400
Virginia Mines (40)	3.56	153	20,300
Salem (27)	<u>0.60</u>	<u>26</u>	<u>3,400</u>
Subtotal	100.00	801	\$ 570,100
Grand total			\$1,034,300

* Based on the three reservoirs operating in series as a combined system. System's total benefits allocated to each reservoir in relation to amount of storage available for downstream releases.

**Based on storage available in individual reservoir, acting independently of lowermost reservoir. Percent figures reflect degree of reservoir's contribution to Meramec sub-basin's share of reach M-7 total demand and are based on the storage dedicated and made available for downstream releases.

TABLE R-16
Water quality (ponding)
Basic data - flow requirements (c.f.s.)*

Reservoir	Reach	1970			2020			2070		
		w/o reservoir	w/reservoir	Difference	w/o reservoir	w/reservoir	Difference	w/o reservoir	w/reservoir	Difference
Bourbeuse River	B-1	3	2	1	10	6	4	25	21	4
	Brush Creek (I-35A)	12-3 = 9	5-2 = 3	6	34-10 = 24	18-6 = 12	12	73-25 = 48	55-21 = 34	14
	Red Oak Creek (I-32)	19-12 = 7	6-5 = 1	6	66-34 = 32	19-18 = 1	31	131-73 = 58	56-55 = 1	57
	Union (29)	11	8	3	35	26	9	85	53	32
Big River	B-4									
	Irondale (9)	30	30	-	57	57	-	80	80	-
	Washington Park (5)	32-30 = 2	-	2	63-57 = 6	-	6	87-80 = 7	-	7
	(Systems share, M-7 needs)	32-32 = 0	30-30 = 0	-	63-63 = 0	57-57 = 0	-	87-87 = 0	80-80 = 0	-
Meramec River	BG-4	43	43	-	170	170	-	299	299	-
	Spring Creek (I-28)	4	-	4	18	-	18	22	-	22
	M-1	9-4 = 5	5	-	28-18 = 10	10	-	37-22 = 15	15	-
	M-2	27-9 = 18	23-5 = 18	-	70-28 = 42	52-10 = 42	-	128-37 = 91	106-15 = 91	-
Courtis Creek (I-15A)	M-3	29-27 = 2	-	2	74-70 = 4	-	4	135-128 = 7	-	7
	M-4	29-29 = 0	23-23 = 0	-	74-74 = 0	52-52 = 0	-	135-135 = 0	106-106 = 0	-
	M-5				Flows required for M-7 satisfy M-6 needs					
	M-6									
(from Meramec River sub-basin)	M-7	87	87	-	340	340	-	801	801	-
Total for	M-7	130	130	-	510	510	-	1,100	1,100	-

* Flow requirements furnished by Public Health Service.

TABLE R-17
Water quality (ponding)
Upper basin - value of reduction in flow requirements

Reservoir	Reach	1970				1995				2020				2045				2070			
		Difference in flow requirements c.f.s.	Difference in cost (\$)	Difference in flow requirements ac-ft	Difference in cost (\$)	Difference in flow requirements c.f.s.	Difference in cost (\$)	Difference in flow requirements ac-ft	Difference in cost (\$)	Difference in flow requirements c.f.s.	Difference in cost (\$)	Difference in flow requirements ac-ft	Difference in cost (\$)	Difference in flow requirements c.f.s.	Difference in cost (\$)	Difference in flow requirements ac-ft	Difference in cost (\$)	Difference in flow requirements c.f.s.	Difference in cost (\$)	Difference in flow requirements ac-ft	Difference in cost (\$)
Bourbon River	B-1	1	184	20,000	20,000	1	862	20,000	20,000	4	2,809	336,000	336,000	5	7,390	386,000	386,000	4	9,700	809,000	809,000
	B-2	6	4,121	250,000	250,000	9	8,446	493,000	493,000	12	12,632	1,507,000	1,507,000	13	17,739	2,807,000	2,807,000	14	23,200	3,832,000	3,832,000
	B-3	6	0	-	-	15	12,630	40,000	40,000	31	14,053	125,000	125,000	44	17,739	342,000	342,000	57	28,110	615,000	615,000
	B-4	3	0	-	-	8	277	15,000	15,000	9	1,622	145,000	145,000	21	12,595	650,000	650,000	32	19,896	1,050,000	1,050,000
Big River																					
Washington Park (#5)	BC-2	2	0	-	-	5	(*)	1,300,000	1,300,000	-	-	-	-	-	-	-	-	-	-	-	-
Maramac River																					
Spring Creek (1-28)	H-1	4	2,681	55,000	55,000	12	10,607	605,000	605,000	18	13,739	1,905,000	1,905,000	20	15,216	2,605,000	2,605,000	22	18,608	2,825,000	2,825,000
Courtois Creek (1-15A)	H-4	2	0	-	-	3	0	-	-	4	(*)	2,400,000	2,400,000	-	-	-	-	-	-	-	-

(*) At this point in time, c.f.s. requirements exceeded minimum flow of record, and cost of a low-water dam was used as a measure of benefits.

TABLE R-18
Ponding benefits (net worth)
(Dollars)

Sub-basin and reservoir	Time period	Incremental construction costs	Annual costs*			1970 worth of annual costs*
			Incremental construction costs	Incremental O&M	Total	
Bourbeuse River-Brush Creek (I-35A)	1970	20,000	600	-	600	600
	1995	-	-	-	-	-
	2020	316,000	10,000	-	10,000	1,900
	2045	50,000	1,600	5,000	6,600	400
	2070	423,000	13,400	10,000	23,400	-
	Total	809,000	25,600	15,000	40,600	2,900
Redoak Creek (I-32)	1970	250,000	7,900	-	7,900	7,900
	1995	243,000	7,700	-	7,700	3,500
	2020	1,014,000	32,100	10,000	42,100	7,800
	2045	1,368,000	43,300	30,000	73,300	4,400
	2070	957,000	30,300	15,000	45,300	100
	Total	3,832,000	121,300	55,000	176,300	23,700
Reach B-3 Union (#29)	1970	-	-	-	-	-
	1995	40,000	1,300	-	1,300	600
	2020	85,000	2,700	-	2,700	500
	2045	240,000	7,600	5,000	12,600	800
	2070	250,000	7,900	-	7,900	-
	Total	615,000	19,500	5,000	24,500	1,900
Reach B-4 Union (#29)	1970	-	-	-	-	-
	1995	15,000	500	-	500	200
	2020	130,000	4,100	-	4,100	800
	2045	505,000	16,000	5,000	21,000	1,300
	2070	400,000	12,700	-	12,700	-
	Total	1,050,000	33,300	5,000	38,300	2,300
Big River-Washington Park (#5)	2020	1,300,000	41,100	35,000	76,100	14,100
Meramec River-Spring Creek (I-28)	1970	55,000	1,700	-	1,700	1,700
	1995	550,000	17,400	-	17,400	7,800
	2020	1,300,000	41,100	5,000	46,100	8,600
	2045	700,000	22,200	-	22,200	1,300
	2070	220,000	7,000	-	7,000	-
	Total	2,825,000	89,400	5,000	94,400	19,400
Courtois Creek (I-15A)	2045	2,400,000	76,000	35,000	111,000	6,700

*Annual costs and discounting based on Federal interest rate of 3% and amortization period of 100 years.

TABLE R-19
Summation of water quality benefits

<u>Reservoirs</u>	<u>Low-flow augmentation</u>		<u>Ponding</u>	<u>Total</u>
	<u>Reach 7</u>	<u>Local</u>		
Main stream reservoirs				
(#2A)	\$ 120,100	-	-	\$ 120,100
(#5)	179,800	-	\$14,100	193,900
(#9)	164,300	\$ 283,800	-	448,100
(#40)	20,300	-	-	20,300
(#17)	546,400	-	-	546,400
(#27)	3,400	41,100	-	44,500
(#29)	-	427,700	4,200	431,900
Tributary reservoirs				
(I-14)	-	-	-	-
(I-15A)	-	-	6,700	6,700
(I-21)	-	-	-	-
(I-23)	-	70,200	-	70,200
(I-26)	-	-	-	-
(I-28)	-	40,200	19,400	59,600
(I-30)	-	-	-	-
(I-32)	-	3,600	23,700	27,300
(I-33A)	-	155,900	-	155,900
(I-35A)	-	142,400	2,900	145,300
(I-38)	-	143,100	-	143,100
(I-41)	-	-	-	-
Grand total	\$1,034,300	\$1,308,000	\$71,000	\$2,413,300

TABLE R-20
Supplemental water supply requirements
(Lower basin)

<u>Year of first need</u>	<u>Demand (m.g.d.)</u>	<u>Equivalent flow (c.f.s.)</u>
1995	50	75
2020	100	150
2045	<u>200</u>	<u>300</u>
Total	350	525

TABLE R-21
Supplemental water supply (lower basin)
Value of flow requirements (1)

Demand (m.g.d.)	(c.f.s.) (2)	Year of first need (2)	Pipeline size (2)	Unit cost of pipeline construction (3)	Length of pipeline (4) (miles)	Total pipeline costs	Pumping station and stand pipe costs (5)	Total construction costs
50	75	1995	54"	\$ 358,000	10	\$ 3,580,000	\$ 750,000	\$ 4,330,000
100	150	2020	72"	600,000	10	6,000,000	1,200,000	7,200,000
200	300	2045	2-72"	1,500,000	17	25,500,000	5,000,000	30,500,000

(1) Based on the least costly alternate of securing supplemental flows from the Missouri River.

(2) Data furnished by the U. S. Public Health Service.

(3) Based on information received from the Distribution Section, Water Division, City of St. Louis. Basic data were modified to include additional costs for cathodic protection, pressure testing, and supervision of construction. Costs are for the pipeline in-place with adequate cover, excavation, backfill, etc., and include costs for the pipe, mill-wrapped.

(4) Length of pipeline based on the use of existing street right-of-way. Increase in length for the year 2045 reflects the need to follow a more circuitous route due to the projected growth in St. Louis County and non-availability of existing right-of-way for the route used in the two previous installations.

(5) Data furnished by the U. S. Public Health Service. Basic cost for 2045 was modified to reflect increase in line length.

TABLE R-22
Supplemental water supply (lower basin) - benefits (net worth)

Demand m.g.d.	c.f.s.	Total value construction costs (1)	Annual costs		Total	Year of first need	1970 worth of annual costs (4)
			Construction (2)	O & M (3)			
50	75	\$ 4,330,000	\$ 323,000	\$ 440,000	\$ 763,000	1995	\$ 342,600
100	150	7,200,000	537,000	1,320,000	1,857,000	2020	345,000
200	300	<u>30,500,000</u>	<u>2,274,000</u>	<u>4,356,000</u>	<u>6,630,000</u>	2045	<u>398,100</u>
Total		\$42,030,000	\$3,134,000	\$6,116,000	\$9,250,000		\$1,085,700

(1) Based on data contained in TABLE R-21.

(2) The annual cost to private enterprise for securing the required capital. Computations have been based on borrowing money at 5-1/2% interest rate with a repayment period of 25 years.

(3) Data furnished by the Public Health Service. Basic cost for 2045 was modified to reflect an increase in power costs, horsepower requirements, and line maintenance due to the additional line length.

(4) Discounted at 3% interest rate, amortized over 100-year period.

TABLE R-23

Supplemental flow capability for water supply - main stream and tributary stream reservoirs

Sub-basin	Reservoir	Reach M-7 capability (1) (c.f.s.)	Assigned water quality flows (2) (c.f.s.)	Flow capability remaining for water supply (reach M-7) (c.f.s.)
Big River	9	136	105	31
	I-30	-	-	-
	5	149	116	33
	2A	100	78	22
	System 2A, 5, 9	385	299	86
Meramec River	I-28	11	-	11
	I-23	7	-	7
	I-41	3	-	3
	27	39	26	13
	I-15A	11	-	11
	I-14	10	-	10
	I-26	5	-	5
	17	730	622	108
	40	153	153	-
	System	969	801	168
Bourbeuse River	I-21	3	-	3
	I-35A	10	-	10
	I-38	12	-	12
	I-33A	14	-	14
	I-32	14	-	14
	29	282-53(3) = 229	-	229
	System	282	-	282
Total		1,636	1,100	536

(1) Based on data contained in TABLE R-14.

(2) Based on data contained in TABLE R-15.

(3) 53 c.f.s. for low-flow augmentation, water quality, upper basin in reach B-4, Bourbeuse River.

TABLE R-24
Allocation of reservoir water supply benefits

<u>Reservoir</u>	<u>Flow capability for water supply in reach M-7 (1) (c.f.s.)</u>	<u>Time of need</u>	<u>Flow furnished (c.f.s.)</u>	<u>Reservoir benefits</u>
BOURBEUSE RIVER SUB-BASIN				
Union (29)	229	1995 2020 2045	75 150 <u>4</u>	\$ 314,900 372,700 <u>5,300</u>
Total, Union only			229	\$ 692,900
Bourbeuse River (I-38)	12	2045	12	15,900
Peavine Creek (I-21)	3	2045	3	4,000
Brush Creek (I-35A)	10	2045	8	10,600
Little Bourbeuse River (I-33A)	14	2045	11	14,600
Redoak Creek (I-32)	<u>14</u>	2045	<u>10</u>	<u>13,300</u>
Total - sub-basin	282		273	\$ 751,300
BIG RIVER SUB-BASIN				
Pine Ford (2A)	22	2045	22	\$ 29,500
Washington Park (5)	33	2045	33	44,200
Irondale (9)	<u>31</u>	2045	<u>31</u>	<u>40,400</u>
Total - sub-basin	86		86	\$ 114,100
MERAMEC RIVER SUB-BASIN				
Meramec Park (17)	108	2045	108	\$ 143,300
Salem (27)	13	2045	13	17,200
Spring Creek (I-28)	11	2045	11	14,600
Little Dry Fork Creek (I-23)	7	2045	5	6,700
Benton Creek (I-41)	3	2045	3	4,000
West Fork Huzzah Creek (I-26)	5	2045	5	6,600
Huzzah Creek (I-14)	10	2045	10	13,300
Courtois Creek (I-15A)	<u>11</u>	2045	<u>11</u>	<u>14,600</u>
Total - sub-basin	168		166	\$ 220,300
Total basin - Supply Deficiency	536		525	\$1,085,700

(1) Based on data contained in TABLE R-23.

TABLE R-25
General recreation, average annual benefits - reservoirs

State	Total development \$Bils. (1)	Total attendance (1979) (2)	Bait value per visitor- day (3)	Total bear- fits (1979) (4)-(2)(3)	Division of recreational responsibility			Division of development cost			Division of visitor-day attendance			Division of benefits (1979)		
					State (5)	Other (7)	Federal (6)-(5)-(7)	State (10)-(1)(8)	Other (11)-(1)(9)	State (12)-(1)(10)	Other (13)-(1)(11)	State (14)-(1)(12)	Other (15)-(1)(13)	State (16)-(1)(14)	Other (17)-(1)(15)	
Massachusetts																
State stream reserves																
\$ 3,000,000	1,900,000	1,600,000	1.60	\$ 2,040,000	30.0	35.0	\$ 900,000	\$ 900,000	\$ 1,030,000	\$ 1,030,000	370,000	645,000	\$ 812,000	\$ 812,000	\$ 1,064,000	\$ 1,064,000
5 Washington Park	300,000	300,000	1.60	480,000	40.0	20.0	120,000	120,000	60,000	60,000	120,000	120,000	120,000	120,000	157,000	157,000
1000000	300,000	300,000	1.60	480,000	40.0	20.0	120,000	120,000	60,000	60,000	120,000	120,000	120,000	120,000	157,000	157,000
200,000	300,000	300,000	1.60	480,000	40.0	20.0	120,000	120,000	60,000	60,000	120,000	120,000	120,000	120,000	157,000	157,000
10,500,000	3,013,400	3,013,400	1.60	4,821,760	30.0	40.0	3,150,000	3,150,000	4,200,000	4,200,000	800,100	800,100	1,280,000	1,280,000	1,640,000	1,640,000
2,500,000	1,500,000	1,500,000	1.60	2,400,000	30.0	40.0	750,000	750,000	1,000,000	1,000,000	450,000	450,000	600,000	600,000	720,000	720,000
2,500,000	1,500,000	1,500,000	1.60	2,400,000	30.0	40.0	750,000	750,000	1,000,000	1,000,000	450,000	450,000	600,000	600,000	720,000	720,000
Tribe reserves																
75,000	34,000	86,400	1.60	112,000	80.0	20.0	60,000	50,000	-	-	15,000	43,200	10,800	69,100	12,300	12,300
1-14 Mashash Creek	70,000	70,000	1.60	112,000	80.0	20.0	60,000	100,000	-	-	15,000	43,200	10,800	69,100	12,300	12,300
1-14 Mashash Creek	70,000	70,000	1.60	112,000	80.0	20.0	60,000	100,000	-	-	15,000	43,200	10,800	69,100	12,300	12,300
35,000	35,000	35,000	1.50	52,500	85.0	15.0	27,000	50,000	-	-	7,000	21,000	3,600	21,600	3,400	3,400
1-23 Littleton Creek	35,000	35,000	1.50	52,500	85.0	15.0	27,000	50,000	-	-	7,000	21,000	3,600	21,600	3,400	3,400
61,000	61,000	61,000	1.60	97,600	80.0	20.0	58,000	50,000	-	-	14,100	44,800	10,700	55,500	14,400	14,400
1-26 West Fork Mashash Creek	61,000	61,000	1.60	97,600	80.0	20.0	58,000	50,000	-	-	14,100	44,800	10,700	55,500	14,400	14,400
300,000	200,000	200,000	1.60	320,000	40.0	30.0	120,000	100,000	90,000	90,000	80,000	60,000	60,000	90,000	90,000	90,000
1-28 Spring Creek	300,000	200,000	1.60	320,000	40.0	30.0	120,000	100,000	90,000	90,000	80,000	60,000	60,000	90,000	90,000	90,000
1-30 Terro Steam Creek	100,000	100,000	1.60	160,000	80.0	20.0	80,000	160,000	22,000	22,000	22,400	22,400	22,400	22,400	35,800	35,800
1-30 Terro Steam Creek	100,000	100,000	1.60	160,000	80.0	20.0	80,000	160,000	22,000	22,000	22,400	22,400	22,400	22,400	35,800	35,800
1-30 Terro Steam Creek	100,000	100,000	1.60	160,000	80.0	20.0	80,000	160,000	22,000	22,000	22,400	22,400	22,400	22,400	35,800	35,800
1-30 Terro Steam Creek	100,000	100,000	1.60	160,000	80.0	20.0	80,000	160,000	22,000	22,000	22,400	22,400	22,400	22,400	35,800	35,800
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000	70,000	1.50	105,000	50.0	50.0	60,000	50,000	50,000	50,000	35,000	35,000	35,000	35,000	52,100	52,100
1-35A Little Northwaste River	70,000															

TABLE R-26
Annual fishing benefits - reservoir area

<u>Reservoir</u>	<u>Estimated fisherman-day use</u>			<u>Unit value</u>	<u>Net benefit</u>
	<u>Without project</u> <u>(1)</u>	<u>With project</u> <u>(2)</u>	<u>Net effect</u> <u>(3) = (2) - (1)</u>		
				<u>(4)</u>	<u>(5) = (3) x (4)</u>
Main stream					
Pine Ford (2A)	2,980	202,980	200,000	\$0.97	\$ 193,400
Washington Park (5)	3,370	71,400	68,030	1.23	83,500
Irondale (9)	2,580	83,580	81,000	1.22	98,700
Virginia Mines (40)	14,000	262,000	248,000	1.43	355,700
Meramec Park (17)	48,880	535,280	486,400	1.50	729,600
Salem (27)	2,200	67,200	65,000	1.20	78,200
Union (29)	7,280	247,650	240,370	0.98	234,700
Tributary stream					
Huzzah Creek (I-14)	2,320	15,590	13,270	0.99	13,100
Courtois Creek (I-15A)	3,400	22,000	18,600	1.34	24,900
Peavine Creek (I-21)	90	4,410	4,320	1.55	6,700
Little Dry Fork Creek (I-23)	120	13,640	13,520	1.00	13,500
West Fork Huzzah Creek (I-26)	1,000	14,390	13,390	1.48	19,800
Spring Creek (I-28)	530	14,400	13,870	1.00	13,900
Terre Bleue Creek (I-30)	560	7,560	7,000	0.96	6,700
Redoak Creek (I-32)	640	17,500	16,860	1.00	16,800
Little Bourbeuse River (I-33A)	1,380	18,630	17,250	0.96	16,500
Brush Creek (I-35A)	2,580	17,810	15,230	0.84	12,800
Bourbeuse River (I-38)	1,180	21,870	20,690	0.90	18,600
Benton Creek (I-41)	120	4,750	4,630	1.49	6,900
Headwater					
Dry Creek (H-3)	50	4,830	4,780	1.00	4,800
Cabanne Course (H-4)	30	2,530	2,500	0.96	2,400
Brady Creek (H-5A)	10	1,800	1,790	1.01	1,800
Birch Creek (H-6)	90	6,090	6,000	0.98	5,900
Little Indian Creek (H-8)	240	5,240	5,000	1.00	5,000
Bates Creek (H-9)	70	2,400	2,330	1.03	2,400
Lost Creek (H-10A)	20	1,380	1,360	1.54	2,100
Winsell Creek (H-11A)	90	3,740	3,650	0.99	3,600
Boone Creek (H-13A)	50	6,460	6,410	1.00	6,400
Big River (H-25)	60	2,250	2,190	1.51	3,300
Dry Fork Creek (H-31)	20	1,790	1,770	0.96	1,700
Coonville Creek (H-40)	20	3,020	3,000	1.00	3,000
Total	95,960	1,684,170	1,588,210		\$1,986,400

TABLE R-27
Annual fishing benefits - stream area (upper basin)

Reservoir	Estimated fisherman-day use			Unit value	Net benefits (5)=(4)x(3)
	Without project	With project	Net effect		
	(1)	(2)	(3)=(2)-(1)		
Main stream					
Pine Ford (2A)	26,400	39,600	13,200	\$1.50	\$ 5,100*
Washington Park (5)	2,000	4,000	2,000	2.00	11,700*
Irondale (9)	20,400	30,600	10,200	1.50	22,300*
Virginia Mines (40)	18,000	27,000	9,000	1.25	11,300
Meramec Park (17)	5,000	10,000	5,000	1.50	7,500
Salem (27)	15,000	22,500	7,500	2.50	18,800
Union (29)	20,640	30,960	10,320	1.50	15,500
Tributary stream					
Huzzah Creek (I-14)	13,500	20,250	6,750	2.50	16,900
Courtois Creek (I-15A)	6,000	12,000	6,000	2.00	12,000
Peavine Creek (I-21)	60	70	10	1.00	100
Little Dry Fork Creek (I-23)	150	190	40	1.00	100
West Fork Huzzah Creek (I-26)	80	400	320	2.50	800
Spring Creek (I-28)	300	380	80	1.00	100
Terre Bleue Creek (I-30)	1,760	2,200	440	1.50	700
Redoak Creek (I-32)	240	300	60	1.50	100
Little Bourbeuse River (I-33A)	1,500	3,000	1,500	1.50	2,300
Brush Creek (I-35A)	--	--	--	--	--
Bourbeuse River (I-38)	4,120	8,240	4,120	1.50	6,200
Benton Creek (I-41)	60	120	60	2.00	100
Headwater					
Dry Creek (H-3)	280	350	70	1.00	100
Cabanne Course (H-4)	10	30	20	1.00	100
Brady Creek (H-5A)	--	--	--	--	--
Birch Creek (H-6)	160	200	40	1.00	100
Little Indian Creek (H-8)	580	720	140	1.00	100
Bates Creek (H-9)	20	350	330	1.00	300
Lost Creek (H-10A)	320	600	280	1.50	400
Winsell Creek (H-11A)	220	270	50	1.00	100
Boone Creek (H-13A)	360	450	90	1.00	100
Big River (H-25)	780	980	200	2.00	400
Dry Fork Creek (H-31)	50	60	10	1.00	100
Coonville Creek (H-40)	--	--	--	--	--
Total	137,990	215,820	77,830		\$133,400

* Creditable benefits for reservoirs 2A, 5, and 9 have been modified to reflect a sharing of benefits below Pine Ford Reservoir (2A). Benefits equal to \$19,800 have been prorated between the three reservoirs on the basis of storage available for release below 2A. Consequently, benefits creditable to the three reservoirs were determined as follows:

Reservoir	Local benefits	Creditable benefits for reach below 2A	Total benefits
2A	\$ -	\$ 5,100	\$ 5,100
5	4,000	7,700	11,700
9	15,300	7,000	22,300
Total	\$19,300	\$19,800	\$39,100

TABLE R-28
Annual fishing benefits - stream area (lower basin, reaches M-6 and M-7)

Controlling reservoirs	Estimated fisherman-day use			Unit value (4)	Net benefits (5)=(3)x(4)	Applicable storage for flows (ac-ft) (6)*	Percent Apportionment (7)**	Prorated benefits (8)=(7)x(5)
	Without project (1)	With project (2)	Net effect (3)=(2)-(1)					
1. Reach M-6, Bourbeuse River confluence to Big River confluence	11,000	15,100	4,100	\$1.00	\$ 4,100			
Total for reservoirs						38,424	100.00	\$4,100
Maramac Park (17)						28,684	74.65	\$3,100
Union (29)						9,740	25.35	1,000
2. Reach M-7, Big River confluence to Mississippi River backwater	4,200	6,300	2,100	\$1.00	\$ 2,100			
Total for reservoirs						104,330	100.00	\$2,100
Maramac Park (17)						28,684	27.49	\$ 600
Union (29)						9,740	9.34	200
Big River System						65,906	63.17	1,300
Pine Ford (2A)						(17,056)	(25.88)	(300)
Washington Park (5)						(25,519)	(38.72)	(500)
Irondale (9)						(23,331)	(35.40)	(500)
3. Summary, total benefits								
Maramac Park (17)							\$3,100 + \$600 =	\$3,700
Union (29)							1,000 + 200 =	1,200
Pine Ford (2A)								300
Washington Park (5)								500
Irondale (9)								500
Total								\$6,200

* Required storage in terms of acre-feet for supplemental flows specified by U. S. Fish and Wildlife to improve stream reach for fishing aspects.
** Basis of allocation. Prorated by percent of storage provided by each reservoir to total storage required for specified flows.

TABLE R-29
Annual hunting benefits - reservoir and stream area

Hunterman-day attendance - reservoir		Hunterman-day attendance - stream		Total net effect (7)=(3)-(6)	Unit value (8)	Total value (9)=(7)x(8)
Without project (1)	With project (2)	Without project (4)	With project (5)			
Reservoirs						
Main stream						
2A Pine Ford	600	840	240	240	0	\$ 0
5 Washington Park	140	360	220	10	210	200
9 Irondale	216	1,000	784	246	538	1,600
40 Virginia Mines	994	4,250	800	44	756	3,600
17 Meramec Park	994	4,250	3,256	10	3,246	9,700
27 Salem	190	750	560	80	480	1,400
29 Union	950	2,300	1,350	92	1,258	3,800
Tributary stream						
I-14 Huzzah Creek	40	240	200	8	192	500
I-15A Courtis Creek	45	250	205	10	195	600
I-21 Peavine Creek	58	100	42	16	34	100
I-23 Little Dry Fork Creek	40	150	110	8	102	300
I-26 West Fork Huzzah Creek	45	250	205	0	205	600
I-28 Spring Creek	80	250	170	2	168	500
I-30 Terre Bleue Creek	22	200	178	30	148	400
I-32 Redoak Creek	160	400	240	14	226	700
I-33A Little Bourbeuse Creek	120	300	180	10	170	500
I-35A Brush Creek	134	300	166	0	166	500
I-38 Bourbeuse River	130	400	270	46	224	700
I-41 Benton Creek	40	150	110	10	100	300
Headwater						
H-3 Dry Creek	20	100	80	17	63	200
H-4 Cabanne Course	12	50	38	0	38	100
H-5A Brady Creek	4	100	96	0	96	300
H-6 Birch Creek	22	100	78	2	76	200
H-8 Little Indian Creek	12	200	188	10	178	600
H-9 Bates Creek	8	50	42	6	36	100
H-10A Lost Creek	6	100	94	4	90	200
H-11A Winsell Creek	20	100	80	10	70	200
H-13A Boone Creek	38	150	112	32	80	200
H-25 Big River	8	100	92	8	84	300
H-31 Dry Fork Creek	15	50	35	6	29	100
H-40 Coonville Creek	4	50	46	8	38	100
Total	4,623	14,890	10,267	971	9,296	\$28,600

TABLE R-30
Summary of annual fishing and hunting benefits - reservoir and stream

Reservoir	Reservoir fishing benefits	Reservoir and stream hunting benefits	Total reservoir fishing and hunting benefits	Local stream fishing benefits (upper-area)	Reach M-7 fishing benefits	Other fishing benefits	Total stream fishing benefits	Total fishing and hunting benefits
Main stream								
2A Pine Ford	\$ 193,400	\$ 100	\$ 193,500	\$ -	\$ 300	\$ 5,100	\$ 5,400	\$ 198,900
5 Washington Park	83,500	200	83,700	4,000	500	7,700	12,200	95,900
9 Irondale	98,700	1,600	100,300	15,300	500	7,000	22,800	123,100
40 Virginia Mines	355,700	3,600	359,300	11,300	-	-	11,300	370,600
17 Meramec Park	729,600	9,700	739,300	7,500	3,700	-	11,200	750,500
27 Salem	78,200	1,400	79,600	18,800	-	-	18,800	98,400
29 Union	234,700	3,800	238,500	15,500	1,200	-	16,700	255,200
Tributary stream								
I-14 Huzzah Creek	13,100	500	13,600	16,900	-	-	16,900	30,500
I-15A Courtois Creek	24,900	600	25,500	12,000	-	-	12,000	37,500
I-21 Peavine Creek	6,700	100	6,800	100	-	-	100	6,900
I-23 Little Dry Fork Creek	13,500	300	13,800	100	-	-	100	13,900
I-26 West Fork Huzzah Creek	19,800	600	20,400	800	-	-	800	21,200
I-28 Spring Creek	13,900	500	14,400	100	-	-	100	14,500
I-30 Terre Bleue Creek	6,700	400	7,100	700	-	-	700	7,800
I-32 Redoak Creek	16,800	700	17,500	100	-	-	100	17,600
I-33A Little Bourbeuse River	16,500	500	17,000	2,300	-	-	2,300	19,300
I-35A Brush Creek	12,800	500	13,300	-	-	-	-	13,300
I-38 Bourbeuse River	18,600	700	19,300	6,200	-	-	6,200	25,500
I-41 Benton Creek	6,900	300	7,200	100	-	-	100	7,300
Headwater								
H-3 Dry Creek	4,800	200	5,000	100	-	-	100	5,100
H-4 Cabanne Course	2,400	100	2,500	100	-	-	100	2,600
H-5A Brady Creek	1,800	300	2,100	-	-	-	-	2,100
H-6 Birch Creek	5,900	200	6,100	100	-	-	100	6,200
H-8 Little Indian Creek	5,000	600	5,600	100	-	-	100	5,700
H-9 Bates Creek	2,400	100	2,500	300	-	-	300	2,800
H-10A Lost Creek	2,100	200	2,300	400	-	-	400	2,700
H-11A Winsell Creek	3,600	200	3,800	100	-	-	100	3,900
H-13A Boone Creek	6,400	200	6,600	100	-	-	100	6,700
H-25 Big River	3,300	300	3,600	400	-	-	400	4,000
H-31 Dry Fork Creek	1,700	100	1,800	100	-	-	100	1,900
H-40 Coonville Creek	3,000	100	3,100	-	-	-	-	3,100
Total	\$1,986,400	\$28,700	\$2,015,100	\$113,600	\$6,200	\$19,800	\$139,600	\$2,154,700

TABLE R-31
Summary of total recreational benefits

<u>Reservoirs</u>	<u>Total fish and wildlife benefits</u>	<u>General recreation</u>	<u>Total recreation</u>
Main stream			
Pine Ford (2A)	\$ 198,900	\$ 912,000	\$1,110,900
Washington Park (5)	95,900	192,000	287,900
Irondale (9)	123,100	377,600	500,700
Virginia Mines (40)	370,600	1,280,000	1,650,600
Meramec Park (17)	750,500	1,446,600	2,197,100
Salem (27)	98,400	320,000	418,400
Union (29)	255,200	720,000	975,200
Tributary stream			
Huzzah Creek (I-14)	30,500	69,100	99,600
Courtois Creek (I-15A)	37,500	39,600	127,100
Peavine Creek (I-21)	6,900	21,600	28,500
Little Dry Fork Creek (I-23)	13,900	176,000	189,900
West Fork Huzzah Creek (I-26)	21,200	78,100	99,300
Spring Creek (I-28)	14,500	128,000	142,500
Terre Bleue Creek (I-30)	7,800	128,000	135,800
Redoak Creek (I-32)	17,600	107,500	125,100
Little Bourbeuse River (I-33A)	19,300	63,000	82,300
Brush Creek (I-35A)	13,300	52,500	65,800
Bourbeuse River (I-38)	25,500	200,000	225,500
Benton Creek (I-41)	7,300	12,000	19,300
Headwater			
Dry Creek (H-3)	5,100	36,800	41,900
Cabanne Course (H-4)	2,600	28,800	31,400
Brady Creek (H-5A)	2,100	21,000	23,100
Birch Creek (H-6)	6,200	93,600	99,800
Little Indian Creek (H-8)	5,700	86,400	92,100
Bates Creek (H-9)	2,800	21,600	24,400
Lost Creek (H-10A)	2,700	5,400	8,100
Winsell Creek (H-11A)	3,900	57,000	60,900
Boone Creek (H-13A)	6,700	72,000	78,700
Big River (H-25)	4,000	14,400	18,400
Dry Fork Creek (H-31)	1,900	6,000	7,900
Coonville Creek (H-40)	3,100	44,000	47,100
Total	\$2,154,700	\$6,860,600	\$9,015,300

TABLE R-32
Navigation benefit - derivation of benefits

System	1970			1995			2020			2045		
	Storage for required flows (acre-feet)	Percent of total storage		Storage for required flows (acre-feet)	Percent of total storage		Storage for required flows (acre-feet)	Percent of total storage		Storage for required flows (acre-feet)	Percent of total storage	Total
Storage required for downstream releases												
Meramec River	28,684	27.49		28,684	27.49		56,736	35.87		268,176	43.60	
Big River	65,906	63.17		65,906	63.17		65,906	41.67		90,885	14.78	
Bourbeuse River	9,740	9.34		9,740	9.34		35,222	22.46		255,939	41.62	
Total storage provided	104,330	100.00		104,330	100.00		158,167	100.00		615,000	100.00	
Value of storage (based on \$0.3756/acre-foot storage)	\$39,200			\$39,200			\$59,400			\$231,000		\$231,000
Incremental value of storage	\$39,200			-			\$20,200			\$171,600		\$146,000
Benefits (value discounted at 3%)	\$39,200			-			\$ 3,800			\$103,000		\$146,000

TABLE R-33
Navigation benefits - allocation of benefits

System	1970			1995			2020			2045		
	System Benefits	Reservoir Benefits	% of Benefits	System Benefits	Reservoir Benefits	% of Benefits	System Benefits	Reservoir Benefits	% of Benefits	System Benefits	Reservoir Benefits	Total System Benefits
Meramec River system	27.49	\$10,800	27.49	-	-	-	35.87	\$1,400	35.87	43.60	\$44,900	\$ 57,100
Meramec Park	63.17	24,800	25.88	-	-	-	41.67	1,600	25.88	14.78	15,200	41,600
Big River system	9.34	3,600	38.72	-	-	-	-	-	38.72	-	-	3,900
Fine Ford			35.40	-	-	-	-	-	35.40	-	-	5,900
Washington Park				-	-	-	-	-		-	-	5,400
Ironville				-	-	-	-	-		-	-	
Bourbeuse River system				-	-	-	22.46	800	22.46	41.62	42,900	47,300
Union				-	-	-	-	-	-	-	-	
Total	100.00	\$39,200		-	-	-	100.00	\$3,800		100.00	\$103,000	\$146,000

TABLE R-34
Area reorientation benefits - savings in unemployment compensation, project construction

Reservoir	County	Construction period (yrs.) (1)	Const. cost (2)	Wage component (3)=(20%)x(2)	Value of wage comp. (4)=(3)x (1.04- $\frac{1}{2}$)(1)x(3%))	Annual equivalent benefits (5)=(4)x.03165
Main stream reservoirs						
Washington Park	Washington	4	\$13,125,000	\$2,625,000	\$2,782,500	\$ 88,100
Irondale	Washington	4	9,669,000	1,933,800	2,049,800	64,900
Virginia Mines	Franklin	4	12,084,000	2,416,800	2,561,800	81,100
Maramec Park	Franklin	5	10,795,000	2,159,000	2,320,900	73,500
Salem	Dent	4	11,275,000	2,255,000	2,390,300	75,700
Union	Franklin	4	16,033,000	3,206,600	3,399,000	107,600
Tributary reservoirs						
Courtois Creek	Washington	2	\$ 5,178,000	\$1,035,600	\$1,066,700	\$ 33,800
West Fork Huzzah Cr.	Dent	2	3,129,000	625,800	644,600	20,400
Spring Creek	Dent	2	3,097,000	619,400	638,000	20,200
Terre Bleue Creek	St. Genevieve	2	2,464,000	492,800	507,600	16,100
Redoak Creek	Franklin	2	2,350,200	470,000	484,100	15,300
Little Bourbeuse R.	Franklin	2	3,758,000	751,600	774,100	24,500
Headwater reservoirs						
Cabanne Course	St. Francois	-	\$ 415,000	\$ 83,000	\$ 83,000	\$ 2,600
Brady Creek	Franklin	-	197,000	39,400	39,400	1,200
Birch Creek	Franklin	-	419,000	83,800	83,800	2,700
Little Indian Creek	Washington	-	529,000	105,800	105,800	3,300
Bates Creek	Washington	-	316,000	63,200	63,200	2,000
Lost Creek	Washington	-	301,000	60,200	60,200	1,900
Winsell Creek	Franklin	-	134,000	26,800	26,800	900
Boone Creek	Franklin	-	348,000	69,600	69,600	2,200
Big River	Iron	-	301,000	60,200	60,200	1,900
Coonville Creek	St. Francois	-	268,000	53,600	53,600	1,700
Total						\$641,600

TABLE R-35
Area reorientation benefits
Savings in unemployment compensation, project operation

Reservoir	County	Annual O&M costs (labor costs only) (1)	Value of labor costs (2) = (1) x 4.28236	Annual equivalent benefits (3) = (2) x 0.03165
Main stream reservoirs				
Washington Park	Washington	\$ 86,000	\$368,300	\$11,700
Irondale	Washington	106,000	453,900	14,400
Virginia Mines	Franklin	205,000	877,900	27,800
Meramec Park	Franklin	N/A	N/A	N/A
Salem	Dent	100,000	428,200	13,600
Union	Franklin	145,000	620,900	19,700
Tributary reservoirs				
Courtois Creek	Washington	50,000	214,100	6,800
West Fork Huzzah Cr.	Dent	37,000	158,500	5,000
Spring Creek	Dent	56,000	239,800	7,600
Terre Bleue Creek	St. Genevieve	55,000	235,500	7,500
Redoak Creek	Franklin	53,000	227,000	7,300 (60%)
Little Bourbeuse River	Franklin	45,000	192,700	6,100
Headwater reservoirs				
Cabanne Course	St. Francois	9,000	38,500	1,200
Brady Creek	Franklin	9,000	38,500	1,200
Birch Creek	Franklin	9,000	38,500	1,200
Little Indian Creek	Washington	9,000	38,500	1,200
Bates Creek	Washington	6,000	25,700	800
Lost Creek	Washington	6,000	25,700	800
Winnell Creek	Franklin	9,000	38,500	1,200
Boone Creek	Franklin	9,000	38,500	1,200
Big River	Franklin	9,000	38,500	1,200
Coonville Creek	Iron	6,000	25,700	800
	St. Francois	9,000	38,500	1,200
Total				\$135,300

TABLE P-36
Wage component of tourist dollar

Item of expense	Estimated expenditure per capita per day Fed. res. (1)	Percent division of expenditure at Federal tourist rate (2)		Estimated expenditure per capita per day Fed. res. (3)-(1)+(2)	Goods purchased	Owners compensation		Money available for bill to owner (3)-(3)+(4a)	Money available per time (4)-(3)+(4b)	Total money available per time (7)-(3)+(6)	Revised total money available (8)
		In or near reservoir	Elsewhere			Wages (4a)	Other (4b)				
Food:											
In restaurants	\$1.00	65%	35%	0	52%	8%	20%	\$.13	\$.07	\$.20	\$.206
From groceries	1.00	10%	5%	85%	85%	5%	5%	-	-	-	-
Lodging:											
Transportation: Gas and oil	.50	60%	40%	0	25%	15%	30%	.09	.04	.13	.136
Other	1.00	25%	15%	60%	75%	8%	8%	.02	.02	.04	.041
Miscellaneous:											
(Other)	.25	25%	15%	60%	65%	10%	15%	.01	-	.01	.010
Subtotal	1.50	50%	15%	35%	60%	15%	18%	.03	.02	.12	.126
	\$5.25			\$2.11				\$.30	\$.20	\$.50	\$.515

(1) Based on data contained in Table 3, Page 84, OMSC Study Report No. 24.
 (2) Based on data contained in Table 4, Page 84, OMSC Study Report No. 24.
 (3) Based on data contained in Table 5, Page 89, OMSC Study Report No. 24.
 (4) Assume 50% of "Others" will generate additional service jobs, essentially part-time work.
 The remaining 50% will be for taxes, maintenance and replacement costs.
 (5) Reflects the increase in value from 1940 to 1963 price levels by use of Consumer Price Index.

TABLE R-37
Area reorientation
Assessment of accruing wages

<u>Reservoir</u>	<u>Corps of Engineers share visitor-day attendance (1)</u>	<u>Accruable wages (2)</u>
Main stream reservoirs		
Pine Ford (2A)	570,000	\$ 293,600
Washington Park (5)	120,000	61,800
Irondale (9)	236,000	121,500
Virginia Mines (40)	800,000	412,000
Meramec Park (17)	904,100	465,600
Salem (27)	200,000	103,000
Union (29)	450,000	231,800
Tributary reservoirs		
Huzzah Creek (I-14)	43,200	22,200
Courtois Creek (I-15A)	56,000	28,800
Peavine Creek (I-21)	14,400	7,400
Little Dry Fork Creek (I-23)	110,000	56,700
West Fork Huzzah Creek (I-26)	48,800	25,100
Spring Creek (I-28)	80,000	41,200
Terre Bleue Creek (I-30)	80,000	41,200
Redoak Creek (I-32)	67,200	34,600
Little Bourbeuse River (I-33A)	42,000	21,600
Brush Creek (I-35A)	35,000	18,000
Bourbeuse River (I-38)	125,000	64,400
Benton Creek (I-41)	8,000	4,100
Headwater reservoirs		
Dry Creek (H-3)	24,500	12,600
Cabanne Course (H-4)	18,000	9,300
Brady Creek (H-5)	14,000	7,200
Birch Creek (H-6)	58,500	30,100
Little Indian Creek (H-8)	54,000	27,800
Bates Creek (H-9)	13,500	7,000
Lost Creek (H-10)	3,600	1,900
Winsell Creek (H-11)	38,000	19,600
Boone Creek (H-13)	45,000	23,200
Big River (H-25)	9,000	4,600
Dry Fork Creek (H-31)	4,000	2,100
Coonville Creek (H-40)	27,500	14,200

\$2,214,200

(1) Visitor-day attendance shown is that share of the total visitation creditable to the Corps of Engineers expenditures for recreational facilities. Derivation is shown in TABLE R-25.

(2) Based on \$.515/visitor-day and Federal share of projected 1970 visitor-day attendance.

TABLE R-38
Area reorientation - assessment of local economic impact
(all costs in \$1,000)

County	Deposits on hand (62) (1)	Projected depos- its (70) (2)	% of county in basin (3)	Amount of deposits applicable for evaluation (4)	Annual growth (5)=(4)x4.5%	Annual equivalent benefits (6) (3% @ 100 yrs)
Crawford	\$ 6,211	\$11,304	100	\$11,304		
Dent	6,426	9,896	65	6,432		
Franklin	36,832	54,880	64	35,123		
Gasconade	6,807	8,713	32	2,788		
Iron	5,157	8,406	25	2,102		
Maries	3,397	6,692	21	1,405		
Phelps	12,877	22,792	40	9,117		
St. Francois	18,635	28,139	39	10,974		
Ste. Genevieve	9,931	14,201	7	994		
Washington	7,067	10,813	100	<u>10,813</u>		
Total				\$91,052	\$4,097.3	\$1,987.2

- (1) Deposit figures given reflect only time and demand deposits and exclude Government and inter-bank deposits. Only those counties of which part or all are within the basin boundaries have been used in this study.
- (2) Projected deposit figures are based on the last 8 years of growth (1954-1962) and reflect current economic trends and inflationary effects that would continue without the reservoirs assumed in place and in operation.
- (3) To be conservative, the basin's economic base (in terms of bank deposits) was modified by reducing the counties' figures in relation to the percent of land (township) within the basin's boundary to the counties' total lands.
- (6) Reflects continuous growth over 20 years, discounted and amortized at 3% over 100-year period.

TABLE R-39
Area reorientation
Allocation of local economic impact benefits

<u>Reservoir</u>		<u>Estimated reservoir visitor-day attendance (1)</u>	<u>Percent basis</u>	<u>Benefits</u>
Main stream				
Pine Ford	(2A)	570,000	13.26	\$ 263,500
Washington Park	(5)	120,000	2.79	55,400
Irondale	(9)	236,000	5.49	109,100
Virginia Mines	(40)	800,000	18.61	369,800
Meramec Park	(17)	904,100	21.03	417,900
Salem	(27)	200,000	4.65	92,400
Union	(29)	450,000	10.47	208,100
Tributary				
Huzzah Creek	(I-14)	43,200	1.00	19,900
Courtois Creek	(I-15A)	56,000	1.30	25,800
Peavine Creek	(I-21)	14,400	0.33	6,600
Little Dry Fork Creek	(I-23)	110,000	2.56	50,900
W. Fork Huzzah Creek	(I-26)	48,800	1.14	22,600
Spring Creek	(I-28)	80,000	1.86	37,000
Terre Bleue Creek	(I-30)	80,000	1.86	37,000
Redoak Creek	(I-32)	67,200	1.56	31,000
Little Bourbeuse R.	(I-33A)	42,000	0.98	19,500
Brush Creek	(I-35A)	35,000	0.81	16,100
Bourbeuse River	(I-38)	125,000	2.91	57,800
Benton Creek	(I-41)	8,000	0.91	3,800
Headwater				
Dry Creek	(H-3)	24,500	0.57	11,300
Cabanne Course	(H-4)	18,000	0.42	8,300
Brady Creek	(H-5A)	14,000	0.33	6,500
Birch Creek	(H-6)	58,500	1.36	27,000
Little Indian Creek	(H-8)	54,000	1.26	25,000
Bates Creek	(H-9)	13,500	0.31	6,200
Lost Creek	(H-10A)	3,600	0.08	1,600
Winsell Creek	(H-11A)	38,000	0.88	17,500
Boone Creek	(H-13A)	45,000	1.05	20,900
Big River	(H-25)	9,000	0.21	4,200
Dry Fork Creek	(H-31)	4,000	0.09	1,800
Coonville Creek	(H-40)	27,500	0.64	12,700
Total				\$1,987,200

(1) Visitor-day attendance shown is that share of the total visitation creditable to Federal expenditures for recreational facilities.

TABLE R-40
Summation of area reorientation benefits

Reservoir	Savings in unemployment compensation			Local economic development		Total area reorientation benefits
	Project construction	Project operation	Total	Accruing wages	Local economic impact	
Main stream reservoirs						
Pine Ford	(2A)	\$ -	\$ -	\$ 293,600	\$ 263,500	\$ 557,100
Washington Park	(5)	88,100	11,700	99,800	61,800	217,000
Irondale	(9)	64,900	14,400	79,300	121,500	309,900
Virginia Mines	(40)	81,100	27,800	108,900	412,000	890,700
Meramec Park	(17)	73,500	N/A	73,500	465,600	957,000
Salem	(27)	75,700	13,600	89,300	103,000	284,700
Union	(29)	107,600	19,700	127,300	231,800	567,200
Tributary reservoirs						
Huzzah Creek	(I-14)	-	-	22,200	19,900	42,100
Courtois Creek	(I-15A)	33,800	6,800	40,600	28,800	95,200
Peavine Creek	(I-21)	-	-	-	7,400	14,000
Little Dry Fork Creek	(I-23)	-	-	-	56,700	107,600
West Fork Huzzah Creek	(I-26)	20,400	5,000	25,400	25,100	47,700
Spring Creek	(I-28)	20,200	7,600	27,800	41,200	78,200
Terre Bleue Creek	(I-30)	16,100	7,500	23,600	41,200	78,200
Red Oak Creek	(I-32)	15,300	4,300	19,600	34,600	85,200
Little Bourbeuse River	(I-33A)	24,500	6,100	30,600	21,600	71,700
Brush Creek	(I-35A)	-	-	-	18,000	34,100
Bourbeuse River	(I-38)	-	-	-	64,400	122,200
Benton Creek	(I-41)	-	-	-	4,100	7,900
Headwater reservoirs						
Dry Creek	(H-3)	-	-	-	12,600	23,900
Cabanne Course	(H-4)	2,600	1,200	3,800	9,300	21,400
Brady Creek	(H-5A)	1,200	1,200	2,400	7,200	16,100
Birch Creek	(H-6)	2,700	1,200	3,900	30,100	61,000
Little Indian Creek	(H-8)	3,300	1,200	4,500	27,800	57,300
Bates Creek	(H-9)	2,000	800	2,800	7,000	16,000
Lost Creek	(H-10A)	1,900	800	2,700	1,900	6,200
Winsell Creek	(H-11A)	900	1,200	2,100	17,500	39,200
Boone Creek	(H-13A)	2,200	1,200	3,400	23,200	47,500
Big River	(H-25)	1,900	800	2,700	4,600	11,500
Dry Fork Creek	(H-31)	-	-	-	2,100	3,900
Coonville Creek	(H-40)	1,700	1,200	2,900	12,700	29,800
Total		\$641,600	\$135,300	\$776,900	\$2,214,200	\$4,978,300

TABLE R-41
Detrimental or negative benefits to overland transportation - reservoirs (1)

Reservoir	Road relocation	Traffic count (2)			Alteration raise (ft)	Alignment change (miles)	Annual negative benefits (3)		
		Passenger cars	Trucks	Total			Passenger cars	Trucks	Total
Main stream reservoirs									
Pine Ford (2A)	S-1	900	-	900	60	-	\$ 1,300	-	\$ 1,300
	S-2	342	-	342	70	-	600	-	600
	S-3	342	-	342	70	-	600	-	600
	S-4	228	-	228	12	-	100	-	100
	S-5	3,750	450	4,200	20	-	1,800	\$ 1,400	3,200
	S-6	114	-	114	25	-	100	-	100
Total, Pine Ford							\$ 4,500	\$ 1,400	\$ 5,900
Washington Park (5)	S-2	525	-	525	23	-	\$ 300	-	\$ 300
Total, Washington Park							\$ 300	-	\$ 300
Irondale (9)	S-2	1,350	150	1,500	14	-	\$ 500	\$ 300	\$ 800
Total, Irondale							\$ 500	\$ 300	\$ 800
Virginia Mines (40)	S-1	990	-	990	96	-	\$ 2,300	-	\$ 2,300
	A-2	1,500	-	1,500	4	-	100	-	100
Total, Virginia Mines							\$ 2,400	-	\$ 2,400
Maramac Park (17)	S-2	1,470	180	1,650	11	-	\$ 400	\$ 300	\$ 700
	S-3	342	-	342	29	-	200	-	200
	S-4	212	-	212	11	-	100	-	100
	C-3	64	-	64	266	1.3	3,500	-	3,500
	C-6	107	-	107	31	-	100	-	100
	C-7	107	-	107	35	-	100	-	100
	C-8	43	-	43	-	2.3	3,600	-	3,600
	Total, Maramac Park							\$ 8,000	\$ 300
Salom (27)	-	-	-	-	-	-	-	-	
Total, Salom							-	-	-
Union (29)	S-2	194	-	194	14	-	\$ 100	-	\$ 100
	C-1	86	-	86	110	1.3	4,300	-	4,300
	C-2	43	-	43	130	0.4	800	-	800
	C-3	214	-	214	114	-	600	-	600
Total, Union							\$ 5,800	-	\$ 5,800
Tributary reservoirs									
Hussah Creek (I-14)	-	-	-	-	-	-	-	-	
Total, I-14							-	-	-
Courtois Creek (I-15A)	-	-	-	-	-	-	-	-	
Total, I-15A							-	-	-
Peavine Creek (I-21)	-	-	-	-	-	-	-	-	
Total, I-21							-	-	-
Little Dry Fork Creek (I-23)	S-1	457	-	457	60	-	\$ 700	-	\$ 700
Total, I-23							\$ 700	-	\$ 700
West Fork Hussah Creek (I-26)	-	-	-	-	-	-	-	-	
Total, I-26							-	-	-
Spring Creek (I-28)	-	-	-	-	-	-	-	-	
Total, I-28							-	-	-
Terre Bleue Creek (I-30)	S-1	160	-	160	20	-	\$ 100	-	\$ 100
Total, I-30							\$ 100	-	\$ 100
Redoak Creek (I-32)	S-1	228	-	228	10	-	\$ 100	-	\$ 100
Total, I-32							\$ 100	-	\$ 100
Little Bourbeuse River (I-33A)	C-1	107	-	107	20	-	\$ 100	-	\$ 100
Total, I-33A							\$ 100	-	\$ 100
Brush Creek (I-35A)	S-1	1,170	120	1,290	18	-	\$ 800	-	\$ 800
	S-2	157	-	157	18	-	100	-	100
	C-1	64	-	64	120	-	200	-	200
	C-3	64	-	64	80	-	100	-	100
Total, I-35A							\$ 1,200	-	\$ 1,200
Bourbeuse River (I-38)	C-2	161	-	161	23	-	\$ 100	-	\$ 100
Total, I-38							\$ 100	-	\$ 100
Benton Creek (I-41)	C-1	107	-	107	40	-	\$ 100	-	\$ 100
Total, I-41							\$ 100	-	\$ 100

(1) Only those roads which have been altered or relocated with resulting negative benefits are shown.

(2) Average annual 24-hour traffic count - projected to 2020.

(3) Based on the following unit values: Passenger cars - \$0.0000672 per foot of lift and \$0.10/mile of road length increase; trucks - \$0.0004108 per foot of lift and \$0.186/mile of road length increase. Annual benefits computed as equal to the projected average daily traffic count x change (in feet or miles) x the applicable unit value x 365 (days).

TABLE E-42
Summation of benefits - main stream reservoirs

Reservoirs	Flood Control		Water quality	Water supply	Recreation			Navigation	Subtotal	Negative benefits	Total net benefits
	Total	Mississippi			Total	General	Fishing & hunting				
Pine Ford (2A)	\$ 551,700	\$ 91,200	\$ 120,100	\$ 29,500	\$ 1,110,900	\$ 912,000	\$ 198,900	\$ 557,100	\$ 2,380,000	\$ 5,900	\$ 2,374,100
Washington Park (5)	-	-	193,900	44,200	287,900	192,000	95,900	217,000	759,100	300	758,800
Irondale (9)	60,900	-	448,100	40,400	500,700	377,600	123,100	309,900	1,374,800	800	1,374,000
Virginia Mines (40)	-	-	20,300	-	1,650,600	1,280,000	370,600	890,700	2,561,600	2,400	2,559,200
Meramec Park (17)	785,700	284,200	546,400	143,300	2,197,100	1,446,600	750,500	957,000	4,686,600	8,300	4,678,300
Salem (27)	74,100	-	44,500	17,200	418,400	320,000	98,400	284,700	838,900	-	838,900
Union (29)	450,700	142,400	431,900	692,900	975,200	720,000	255,200	567,200	3,165,200	5,800	3,159,400
Total benefits, main stream reservoirs	\$1,923,100	\$517,800	\$1,805,200	\$967,500	\$7,140,800	\$5,248,200	\$1,892,600	\$3,783,600	\$15,766,200	\$23,500	\$15,742,700

TABLE R-43
Summation of benefits - tributary reservoirs

Reservoirs	Flood* control	Water quality	Water supply	Recreation		Fishing & hunting	Area reorientation	Subtotal	Negative benefits	Total net benefits
				Total	General					
Huzzah Creek (I-14)	\$ 41,500	\$ -	\$ 13,300	\$ 99,600	\$ 69,100	\$ 30,500	\$ 42,100	\$ 196,500	\$ -	\$ 196,500
Courtois Creek (I-15A)	29,900	6,700	14,600	127,100	89,600	37,500	95,200	273,500	-	273,500
Peavine Creek (I-21)	48,900	-	4,000	28,500	21,600	6,900	14,000	95,400	-	95,400
Little Dry Fork Creek (I-23)	-	70,200	6,700	189,900	176,000	13,900	107,600	374,400	700	373,700
West Fork Huzzah Creek (I-26)	4,600	-	6,600	99,300	78,100	21,200	73,100	183,600	-	183,600
Spring Creek (I-28)	70,300	59,600	14,600	142,500	128,000	14,500	106,000	393,000	-	393,000
Terre Bleue Creek (I-30)	30,500	-	-	135,800	128,000	7,800	101,800	268,100	100	268,000
Redoak Creek (I-32)	-	27,300	13,300	125,100	107,500	17,600	85,200	250,900	100	250,800
Little Bourbeuse River (I-33A)	-	155,900	14,600	82,300	63,000	19,300	71,700	324,500	100	324,400
Brush Creek (I-35A)	-	145,300	10,600	65,800	52,500	13,300	34,100	255,800	1,200	254,600
Bourbeuse River (I-36)	83,600	143,100	15,900	225,500	200,000	25,500	122,200	590,300	100	590,200
Benton Creek (I-41)	3,700	-	4,000	19,300	12,000	7,300	7,900	34,900	100	34,800
Total benefits, tributary stream reservoirs	\$313,000	\$608,100	\$118,200	\$1,340,700	\$1,125,400	\$215,300	\$860,900	\$3,240,900	\$ 2,400	\$3,238,500

* Local, Marmac River Basin benefits only.

TABLE R-44
Summation of benefits - headwater reservoirs

Reservoirs	Flood* control	Recreation			Area reorientation	Total net benefits
		Total	General	Fishing & hunting		
Dry Creek (H-3)	\$ 26,600	\$ 41,900	\$ 36,800	\$ 5,100	\$ 23,900	\$ 92,400
Cabanne Course (H-4)	-	31,400	28,800	2,600	21,400	52,800
Brady Creek (H-5A)	16,200	23,100	21,000	2,100	16,100	55,400
Birch Creek (H-6)	-	99,800	93,600	6,200	61,000	160,800
Little Indian Creek (H-8)	22,100	92,100	86,400	5,700	57,300	171,500
Bates Creek (H-9)	14,600	24,400	21,600	2,800	16,000	55,000
Lost Creek (H-10A)	26,300	8,100	5,400	2,700	6,200	40,600
Winsell Creek (H-11A)	17,500	60,900	57,000	3,900	39,200	117,600
Boone Creek (H-13A)	24,700	78,700	72,000	6,700	47,500	150,900
Big River (H-25)	3,000	18,400	14,400	4,000	11,500	32,900
Dry Fork Creek (H-31)	-	7,900	6,000	1,900	3,900	11,800
Coonville Creek (H-40)	-	47,100	44,000	3,100	29,800	76,900
Total benefits, headwater reservoirs	\$151,000	\$533,800	\$487,000	\$46,800	\$333,800	\$1,018,600

* Local, Meramec River Basin benefits only.

TABLE R-45
Angler-use sites - Project benefits

<u>Controlling reservoir</u>	<u>Site designation</u>	<u>Name</u>	<u>Fisherman-use days</u>	<u>Unit value</u>	<u>Annual benefits</u>
BIG RIVER SUB-BASIN					
9 Irondale	A	Highway 8			
	B	Terre Bleue Creek			
	C	Highway E			
	D	Washington Park	24,240	\$1.50	\$ 36,400
2A Pine Ford	E	Morse Mill			
	F	Island			
	G	Cedar Hill			
	H	Rockford Beach			
	I	Meramec River confluence	31,680	1.50	47,500
MERAMEC RIVER SUB-BASIN					
27 Salem	J	Wesco			
	K	Benton Creek			
	L	Highway 8			
	M	1,000 Oaks			
	N	Idlewild			
	O	Highway 19	18,000	2.50	45,000
17 Meramec Park	P	Cove Church			
	Q	Little Meramec River			
	R	Robertsville	21,600	2.50	54,000
I-26 and/or I-14	S	Huzzah			
	T	Highway 8	6,480	2.50	16,200
I-15A	U	Highway 8			
	V	Doss Branch	7,200	2.14	15,400
BOURBEUSE RIVER SUB-BASIN					
29 Union	W	Beuscher Creek			
	X	Highway 50			
	Y	Highway 66			
	Z	Meramec River confluence	24,780	1.50	37,200
Total			133,980		\$251,700

TABLE R-46
Local protection projects
Future conditions with reservoirs and without levees

Levee area	2	4	5	7	8	9	11	12	17
Estimated initial year of land conversion to higher order of use	1970	1995	1995	1980	1980	1990	1990	1990	1970
Total acreage subject to flooding*	324	705	1,110	66	380	590	500	900	745
Acreage protected by reservoirs and subject to changed land use	12	0	0	0	70	235	0	175	0
Dollar unit value of land protected by reservoirs and subject to changed land use	1,000/ac	-	-	-	750/ac	800/ac	-	850/ac	0
Total dollar value of land protected by reservoirs and subject to changed land use	12,000	0	0	0	52,500	188,000	0	148,800	0
Acreage subject to changed land use	298	650	1,110	16	310	344	150	630	0
Dollar unit value of land subject to changed use	250/ac	300/ac	450/ac	650/ac	650/ac	700/ac	700/ac	700/ac	400/ac
Total dollar value of land subject to changed use	74,500	195,000	499,500	10,400	201,500	240,800	105,000	441,000	0
Acreage not subject to changed land use	14	55	0	50	0	11**	350	95	745
Average annual damages on acreage not subject to changed land use (\$)	11,100	5,500	0	38,600	0	0	1,000	0	600
Total dollar value of all land subject to changed use	86,500	195,000	499,500	10,400	254,000	428,800	105,000	589,800	0

* Without reservoirs or levees.

**No damage occurs on this acreage since it is used for a sewage lagoon.

TABLE R-47
Local protection projects
Future conditions with reservoirs and levees

Levee area Estimated initial year of land conversion to higher order of use	2	4	5	7	8	9	11	12	17
Total acreage protected	1970 324	1995 705	1995 1,110	1980 66	1980 380	1990 590	1990 500	1990 900	1970 745
Acreage required for levee right- of-way	45	49	93	6*	32	51	46	62	14
Acreage not subject to changed land use	14	55	0	50	0	11	350	95	731
Acreage subject to changed land use	265	601	1,017	10	348	528	104	743	0
Dollar unit value of land with changed use	1,000/ac	10,000/ac	10,000/ac	20,000/ac	65c/sq ft	65c/sq ft	60c/sq ft	75c/sq ft	400/ac
Total dollar value of lands with changed use	265,000	6,010,000	10,170,000	200,000	9,848,400	14,942,400	2,714,400	24,296,100	0
Average annual flood damage	0	0	0	0	0	0	0	0	0

*A total of 22 acres will be required. For analysis purposes, the cost of the incremental 16 acres and development has been included in the project costs in lieu of negative benefits.

TABLE R-48
Average annual flood control benefits
Local protection projects

Levee area Name of area	2	4	5	7	8	9	11	12	17	All areas
Anticipated land use	Telegraph Road truck farming 50 yr.	Starling Airport residential 50 yr.	Butler Lakes residential 50 yr.	Fenton urban comm. 200 yr.	W. Watson Road commercial 200 yr.	Weiss Airport commercial 200 yr.	Valley Park urban comm. 200 yr.	Peerless Park commercial 200 yr.	Fox Creek agricultural 50 yr.	
Degree of levee protection Estimated initial year of land conversion to higher order of use	1970	1995	1995	1980	1980	1990	1990	1990	1970	
Increase in land value in initial year of conversion	178,500	5,815,000	9,670,500	189,600	9,594,000	14,513,600	2,609,400	23,706,300	0	
Annual increase in land value in initial year of conversion based on 5% interest	8,900	290,800	483,500	9,500	479,700	725,700	130,500	1,185,300	0	
Average annual increase in land value discounted at 3% interest	8,900	130,600	217,100	6,900	350,200	384,100	69,100	627,300	0	1,794,200
Average annual flood damages prevented	11,100	5,500	0	38,600	0	0	1,000	0	600	56,800
Total average annual flood control benefits	20,000	136,100	217,100	45,500	350,200	384,100	70,100	627,300	600	1,851,000

TABLE R-49
Reevaluation of reservoir benefits

Reservoir	Flood control	Water quality	Water supply	Recreation		Area reforestation	Subtotal	Negative benefits	Total net benefits
				Total	General				
West Fort Huizah Creek (I-26)									
Original allocation of benefits	\$ 4,600	\$ -	\$ 6,600	\$ 99,300	\$ 78,100	\$ 73,100	\$183,600	\$ -	\$183,600
Revised allocation with I-14 out	46,500 (1)	-	6,600	99,300	78,100	73,100	225,500	-	225,500
Spring Creek (I-28)									
Original allocation of benefits	70,300	59,600	14,600	142,500	128,000	106,000	393,000	-	393,000
Revised allocation with I-23 out	70,300	129,800 (2)	14,600	142,500	128,000	106,000	463,200	-	463,200
Little Bourbeuse River (I-13A)									
Original allocation of benefits	-	155,900	14,600 (3)	82,300	63,000	71,700	324,500	100	324,400
Revised allocation with I-32 out	-	155,900	18,600 (3)	82,300	63,000	71,700	328,500	100	328,400
Brush Creek (I-35A)									
Original allocation of benefits	-	145,300	10,600 (5)	65,800	52,500	34,100	255,800	1,200	254,600
Revised allocation with I-32 out	-	148,900 (4)	13,300 (5)	65,800	52,500	34,100	262,100	1,200	260,900

- (1) Increase primarily due to flood damages prevented and increased returns to cropland on project lands formerly required for reservoir I-14.
 (2) Increase equal to water quality (low-flow augmentation) benefits previously credited to reservoir I-23 for reach M-2 in the upper basin, Hiramac River.
 (3) Increase equal to benefits for an additional 3 c.f.s. of water supply flows in reach M-7. By release of this additional 3 c.f.s., total joint-use storage in reservoir I-33A is completely utilized for downstream releases.
 (4) Increase equal to water quality (low-flow augmentation) benefits previously credited to reservoir I-32 for reach B-2 in the upper basin, Bourbeuse River.
 (5) Increase equal to benefits for an additional 2 c.f.s. of water supply flows in reach M-7. By release of this additional 2 c.f.s., total joint-use storage in reservoir I-35A is completely utilized for downstream releases.

COMPREHENSIVE REPORT

MERAMEC RIVER BASIN,
MISSOURI

APPENDIX S

DIGEST OF PUBLIC OPINION

APPENDIX S

DIGEST OF PUBLIC OPINION

1. SOLICITATION OF PUBLIC OPINION

a. Before the study. A public hearing was held on 7 April 1961 to ascertain the views of the public in regard to the type of development best suited to meet the needs of the basin. (See EXHIBIT A for "Notice of Public Hearing" and EXHIBIT B for "Digest of Public Hearing".)

b. During the study. More than 30 informational meetings were held throughout the basin and surrounding towns so that the public was kept informed of developments as the study progressed. Television, radio, and newspaper coverage was also extensively used for this purpose. In September 1962 an illustrated information bulletin describing the plan of improvement under study was distributed to over 5,000 interested persons.

c. After the study. A synopsis of findings was mailed to 5,000 persons, to accompany notice of public hearing held in St. Clair, Missouri, on 18 December 1963. The purpose of this hearing was to obtain the views of the public in regard to the proposed plan of improvement prior to the District Engineer's recommendations. (See EXHIBIT C for "Notice of Public Hearing", EXHIBIT D for "Synopsis of Findings", and EXHIBIT E for "Digest of Public Hearing".)

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
420 LOCUST STREET
ST. LOUIS 2, MISSOURI

ADDRESS REPLY TO
DISTRICT ENGINEER

REFER TO FILE

7 March 1961

NOTICE OF PUBLIC HEARING
TO CONSIDER THE NEED FOR IMPROVEMENTS FOR
FLOOD CONTROL, WATER CONSERVATION, NAVIGATION,
AND OTHER PURPOSES IN THE MERAMEC RIVER BASIN, MISSOURI

Pursuant to resolution adopted by the Committee on Public Works of the House of Representatives, United States, on 6 April 1960, a public hearing will be held by the District Engineer, St. Louis, at the National Guard Armory, St. Clair, Missouri, on 7 April 1961, starting at 10 a. m. The objectives of the public hearing are, first, to provide an opportunity for all interested parties to be informed of the authorized study; second, to afford all interested parties an opportunity to express their views freely, fully, and publicly concerning the character and extent of improvements desired and the need and advisability of their execution; and, third, to obtain data on the subject of the hearing which would be useful to reporting officers and reviewing authorities in formulating sound report conclusions and recommendations.

The public hearing on the Meramec River Basin was previously scheduled for 26 January 1961, but was postponed because of inclement weather and hazardous driving conditions prevailing on that date. Notice of the rescheduled date is being sent to all known interested parties.

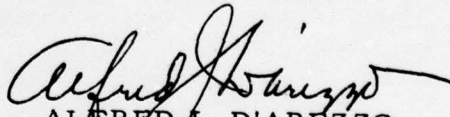

ALFRED J. D'AREZZO
Colonel CE
District Engineer

EXHIBIT A

MERAMEC RIVER BASIN
DIGEST OF PUBLIC HEARING HELD AT
ST. CLAIR, MISSOURI
7 APRIL 1961

A public hearing was held by the District Engineer, U. S. Army Engineer District, St. Louis, on 7 April 1961, at St. Clair, Missouri, to obtain the views of local interests regarding the scope and need for water resource developments in the Meramec River Basin.

The meeting convened at 10 a.m. Approximately 1,400 people were present, representing Federal and State agencies, county and municipal organizations, planning bodies, and numerous individual landowners.

The District Engineer in his opening remarks emphasized that the Corps of Engineers had no plan of improvement for the basin to present at this time, and that the primary purpose of the meeting was to obtain the views of those actively interested in developments for the basin. Representatives of Federal agencies stated that they would cooperate fully with the Corps of Engineers in preparation of the study, and they, in turn, were assured by the District Engineer that the survey would be coordinated with all agencies having an interest in the matter. State agencies, in general, cited the need for a comprehensive plan of improvement which would safeguard the natural resources in the basin and provide the greatest over-all benefits to its residents. The Director of the Missouri Conservation Commission stated that a large scale reservoir program was needed in the Meramec Basin, and that any costs allocated to fish and wildlife conservation should be non-reimbursable Federal costs. The Missouri State Park Board favored a multiple-purpose reservoir on the Meramec with a fairly constant water level located so that a part of the present Meramec State Park would be benefited. It was the feeling of the Board that recreation benefits should receive full Federal funding as does flood control, hydroelectric power, and navigation, and it opposed any assessment of local interests for recreation. A representative of the Meramec Basin Corporation stated that the Corporation was making a comprehensive study of the regional economic problems of the Meramec and its related natural resources, and that continuation of cooperative efforts in the Meramec's problems by all parties is needed if the soundest benefits possible are to accrue to the basin. The Mayors of

numerous communities, as well as representatives of Chambers of Commerce and Rotary and Kiwanis Clubs, expressed the need for improvements which would enhance the economic conditions in the basin.

A few agencies and landowners, some with direct interest in the basin and some with only an objective view, expressed qualified opposition to further consideration for any developments in the basin. The St. Louis County Planning Commission favored zoning the St. Louis County portion of the river valley. A few expressed the opinion that the river should be permitted to remain in its natural state. Others, principally bottom land farmers, contended that if dams were built they would destroy the basin's best farming areas. The Ozark Protective Association and the Jefferson County Farm Bureau, consisting of farmers and property owners residing within and outside the Big River Basin, a major tributary of the Meramec River, objected to any future plan that would include construction of a dam on the lower reaches of Big River. A few objected to further expenditure of Federal funds for the purpose of creating a reservoir for recreational development in the Meramec Basin.

The District Engineer adjourned the meeting at 5:20 p. m.

The net impressions gained from the hearing were:

- a. There has been an increased public awareness and desire for water resources development study of the Meramec Basin.
- b. The overwhelming majority of the public concerned favors the continuation of the Corps of Engineers study and development of the basin.

Data and information obtained at the hearing will be fully analyzed by the Corps of Engineers in formulating a sound plan of basin development to be contained in the report being made under authorization of the House Public Works Committee Resolution adopted 6 April 1960.

U. S. ARMY ENGINEER DISTRICT. ST. LOUIS
CORPS OF ENGINEERS
420 LOCUST STREET
ST. LOUIS, MISSOURI 63102

15 November 1963

NOTICE OF PUBLIC HEARING
TO BE HELD AT THE NATIONAL GUARD ARMORY
SAINT CLAIR, MISSOURI, ON 18 DECEMBER 1963 AT 9:30 A. M.
TO PRESENT THE PLAN OF IMPROVEMENTS FOR
FLOOD CONTROL, WATER CONSERVATION, RECREATION,
FISH AND WILDLIFE CONSERVATION, AND OTHER PURPOSES
IN THE MERAMEC RIVER BASIN, MISSOURI

Pursuant to the following Congressional resolution, the District Engineer, U. S. Army Engineer District, St. Louis, has developed a plan of improvement which will afford the greatest over-all benefits to the basin to meet the needs for flood control, water conservation, recreation, fish and wildlife conservation, and other purposes.

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Meramec River, Missouri, published in House Document Numbered 686, 71st Congress, and other reports, with a view to determining whether the existing project for the Meramec River Basin should be modified in any way at the present time in the interest of flood control, water conservation, navigation, and other purposes. Cooperation, as required by law and regulations, with other Federal agencies will be appropriate. The study shall be coordinated with and will take into account the plans of the Meramec Basin Corporation in matters of Federal interest in the basin."

Adopted 6 April 1960.

In order that the views of local interests may be fully covered in the required report, the District Engineer, U. S. Army Engineer District, St. Louis, will hold a public hearing at the National Guard Armory, 375 Commercial Street (Highway 47, north of town), Saint Clair, Missouri, on 18 December 1963, at 9:30 a. m. Since no other public hearing on this matter is proposed at this time, all interested parties are invited to be

EXHIBIT C

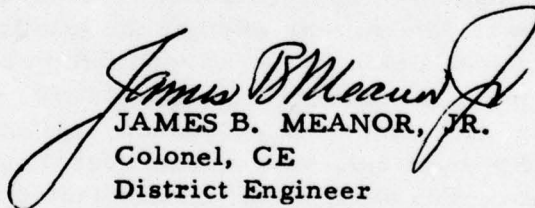
present or represented at the above time and place, including representatives of Federal, State, county, and municipal agencies, and those of commercial, industrial, civic, highway, railroad, water transportation, flood control, and allied interests, as well as property owners and individuals concerned. They will be afforded full opportunity to express their views concerning the improvements proposed and the urgency of constructing various phases of the plan.

An expression is desired of the willingness and ability of non-Federal interests to furnish local cooperation required by law for those improvements found justified and subsequently authorized.

Oral statements will be heard, but for the accuracy of record, all important facts and arguments should be submitted in writing on 8"x10-1/2" paper in five copies, as the records of the hearing will be forwarded for consideration by the Secretary of the Army. Written statements may be handed to the undersigned at the hearing or mailed to him beforehand.

A synopsis of the study, outlining the principal features of the plan of improvement, and including the findings of the District Engineer, will be mailed to all interested parties on 4 December 1963.

Please bring the foregoing to the attention of persons known by you to be interested in this matter.


JAMES B. MEANOR, JR.
Colonel, CE
District Engineer

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
420 LOCUST STREET
ST. LOUIS, MISSOURI 63102

4 December 1963

SYNOPSIS OF FINDINGS
COMPREHENSIVE BASIN STUDY
MERAMEC RIVER, MISSOURI

To supplement
Notice of Public Hearing
to be held at
St. Clair, Missouri
18 December 1963

EXHIBIT D

Comprehensive Basin Study
Meramec River
Missouri

SYNOPSIS OF FINDINGS

1. Background of the Study. Pursuant to Congressional Resolution adopted 6 April 1960, the Corps of Engineers was directed to determine whether the existing project for the Meramec River Basin should be modified in any way at the present time in the interest of flood control, water conservation, navigation, and other purposes. As an initial step in this study, a public hearing was held in St. Clair, Missouri, on 7 April 1961, which was attended by approximately 1,400 persons. The majority favored development of the water resources in the basin for multiple-use purposes.

2. Requirements of the Basin. The flow of the Meramec River is notoriously variable - insufficient during dry summer periods and destructive at other times. In its present condition, it can no longer meet at all times all the burdens and demands for water which are placed upon it. To provide the best use or combination of uses of water and related land resources to meet all foreseeable short- and long-term needs in the basin, consideration has been given in the current study to flood control; low-flow augmentation for water supply, water quality control, and general stream improvement; recreation; fish and wildlife conservation; hydroelectric power; and other purposes.

FLOOD CONTROL

The current average annual flood damage experienced in the Meramec River Basin amounts to \$1,800,000. With anticipated increases in crop yields, these average annual damages will increase substantially in the future if flood protection is not provided.

LOW-FLOW AUGMENTATION

During many periods, the flow of the Meramec River and its tributaries is insufficient to satisfy the water needs of the basin. During these periods, the streams do not carry enough water to provide adequate dilution of the wastes which empty into them, even with adequate source treatment, nor do the stream flows provide favorable habitat for fish and wildlife. This deficiency will become even more severe in the years to come as more intensive development occurs in the upper basin and communities in the lower

basin increase in population and come to depend more and more on the Meramec River for their supply of water. The seasonal low flows of the lower Meramec River must be increased two to three times to meet the needs now foreseen for the next 50 years.

RECREATION

Throughout the Nation there has been an increased demand for outdoor recreational activities, especially around water-based facilities. It can be expected that this trend will continue. A study of the future of outdoor recreation in the greater St. Louis metropolitan region, published in Study Report 21 by the Outdoor Recreation Resources Review Commission (1962), states in part:

"Perhaps even more important, or at least more pressing, than the initiation of regional planning for outdoor recreation is the provision of large water spaces for the outdoor recreation of St. Louisans. If present pressures for water facilities continue to mount at the rates we have anticipated, the failure to act and act quickly in this matter could be crucial. This is not merely a proposal to make life happier for St. Louis water recreationists. It may well be a matter of the life or symbolic death of the city. As amenities become more and more important in the American's choice of a place to live, work, and play, and, as American life becomes more fluid and mobile, St. Louis may well find itself defined as an undesirable area of settlement for many of the people in the land. Since cities must recruit their populations from the outside, St. Louis may find itself suffering severe economic losses without amenities to attract and maintain a growing population. Obviously, the Meramec Basin is the site that must be developed for these purposes. Failure to dam the Meramec might very well mean successfully damning the city."

The Bureau of Outdoor Recreation estimates that a visitor-day attendance of about 12 million persons would result if the reservoirs and recreational facilities in the Basin Plan were provided by 1970.

The Area Redevelopment Administration has stated that one of the largest sources of new employment for the upper Meramec Basin would be that associated with recreation and the tourist trade.

FISH AND WILDLIFE CONSERVATION

The U. S. Fish and Wildlife Service has studied the reservoir sites selected for study in the basin and has found that fisherman-day use of the area would increase from 239,000 fisherman days, now utilizing only natural streams, to 1,900,000 fisherman days, using both the reservoirs included in the Basin Plan together with the improved streams below the reservoirs.

HYDROELECTRIC POWER

The need for including hydroelectric power in the Basin Plan has been pointed out by the Federal Power Commission. However, there is insufficient marketability for such hydroelectric power at this time. Power facilities can be added at a later date should the need become apparent.

3. Coordination with Other Federal Agencies, State of Missouri, and Meramec Basin Corporation. In order to do the best possible job, the combined efforts of all Federal, State, and local agencies in the water resources field were utilized, and their views have been given careful consideration in preparation of the report. The Federal agencies which participated are: the Soil Conservation Service and Forest Service of the Department of Agriculture; the Public Health Service of the Department of Health, Education, and Welfare; the Fish and Wildlife Service, Bureau of Outdoor Recreation, National Park Service, Bureau of Mines, and Southwestern Power Administration of the Department of the Interior; the Federal Power Commission; and the Area Redevelopment Administration of the Department of Commerce. The State of Missouri agencies which participated are: the Water Resources Board, the Division of Geological Survey and Water Resources, the Park Board, the Water Pollution Board, the Highway Commission, the Conservation Commission, the Division of Commerce and Industrial Development, and the University of Missouri Extension Service. As directed in the authorizing resolution, the study has been fully coordinated with, and has taken into account, the plans of the Meramec Basin Corporation in matters of Federal interest in the basin. The St. Louis County Planning Commission has also been consulted.

4. Meramec River Basin Plan. After careful consideration of various alternative methods for satisfying present and future water needs, a system of 31 reservoirs has been selected in the Meramec River Basin, of which seven are on the main streams (Meramec, Big, and Bourbeuse Rivers),

(Estimated Cost of \$151,000,000), 12 are on tributaries of these main streams, (Estimated Cost of \$59,000,000), and 12 are headwater reservoirs, (Estimated Cost of \$7,500,000). Twenty-six angler-use sites are located downstream of these reservoirs for access to the river and resting areas for float fishermen (Estimated Cost of \$690,000). Wildlife development areas are planned by the Forest Service for those reservoirs within Clark National Forest. Nine local flood protection projects are also included in the lower reaches of the Meramec River (Estimated Cost of \$19,000,000). Location of proposed improvements and pertinent data of the Basin Plan are shown on the attached map and data sheet (Atch. 1). This Basin Plan will be used as a guide for the orderly development, conservation, and utilization of the basin's water resources to meet the short- and long-term needs. Hydroelectric power will be retained in the plan for future consideration.

The plan will provide for generally all water requirements necessary to take care of both the short- and long-term needs of the basin. In addition to the primary benefits obtained, the plan would alleviate the effect of drought conditions such as presently exist and have occurred in the past; contribute to the desirable preservation, conservation, and use of the waters of the basin; enhance the economic growth in the area by providing a major contribution to the relief of unemployment in the distressed counties; and increase the basin's potential for industrial development.

5. Early Construction to be Recommended. It is proposed that from the Basin Plan, discussed in paragraph 4 above, specific projects be recommended for immediate authorization and design and construction over the next 10 to 15 years. In this determination, the views and recommendations of all Federal, State, and local agencies that have participated in the study have already been obtained; the views of all other interested parties are now solicited, as stated in NOTICE OF PUBLIC HEARING, dated 15 November 1963. There follows a listing and discussion of those reservoirs and other projects of the Basin Plan which are currently found to be economically justified. From this listing, only those improvements that would best serve the present urgent needs of the basin will be recommended for authorization at this time.

MAIN STREAM RESERVOIRS

All of the main stream reservoirs in the Basin Plan (Pine Ford, Irondale, Washington Park, Meramec Park, Virginia Mines, Salem, and Union) have been found to be economically justified (average annual benefits

exceed the average annual costs, and all project purposes are justified). They would serve present needs for flood control, water quality control, recreation, fish and wildlife conservation, and other project purposes.

TRIBUTARY STREAM RESERVOIRS

The following tributary stream reservoirs in the Basin Plan are economically justified, and all project purposes are justified. These are: I-26 on the upper Huzzah River in Clark National Forest, I-28 on the Spring Creek in the upper Dry Fork area, I-33A on the Little Bourbeuse River, I-35A on Brush Creek (Bourbeuse), and I-38 on the upper Bourbeuse River. The present needs are for flood control, water quality control, recreation, fish and wildlife conservation, and other project purposes.

HEADWATER RESERVOIRS

The following headwater reservoirs in the Basin Plan are economically justified, and all project purposes are justified. These are: H-3 Dry Creek (Big River Sub-basin), H-4 Cabanne Course (Big River Sub-basin), H-5 Brady Creek (Meramec Sub-basin), H-6 Birch Creek (Bourbeuse Sub-basin), H-8 Little Indian Creek (Meramec Sub-basin), H-9 Bates Creek (Big River Sub-basin), H-11 Winsell Creek (Bourbeuse Sub-basin), H-13 Boone Creek (Bourbeuse Sub-basin), and H-25 (upper Big River). The present needs are for flood control, recreation, fish and wildlife conservation, and other project purposes.

ANGLER-USE SITES

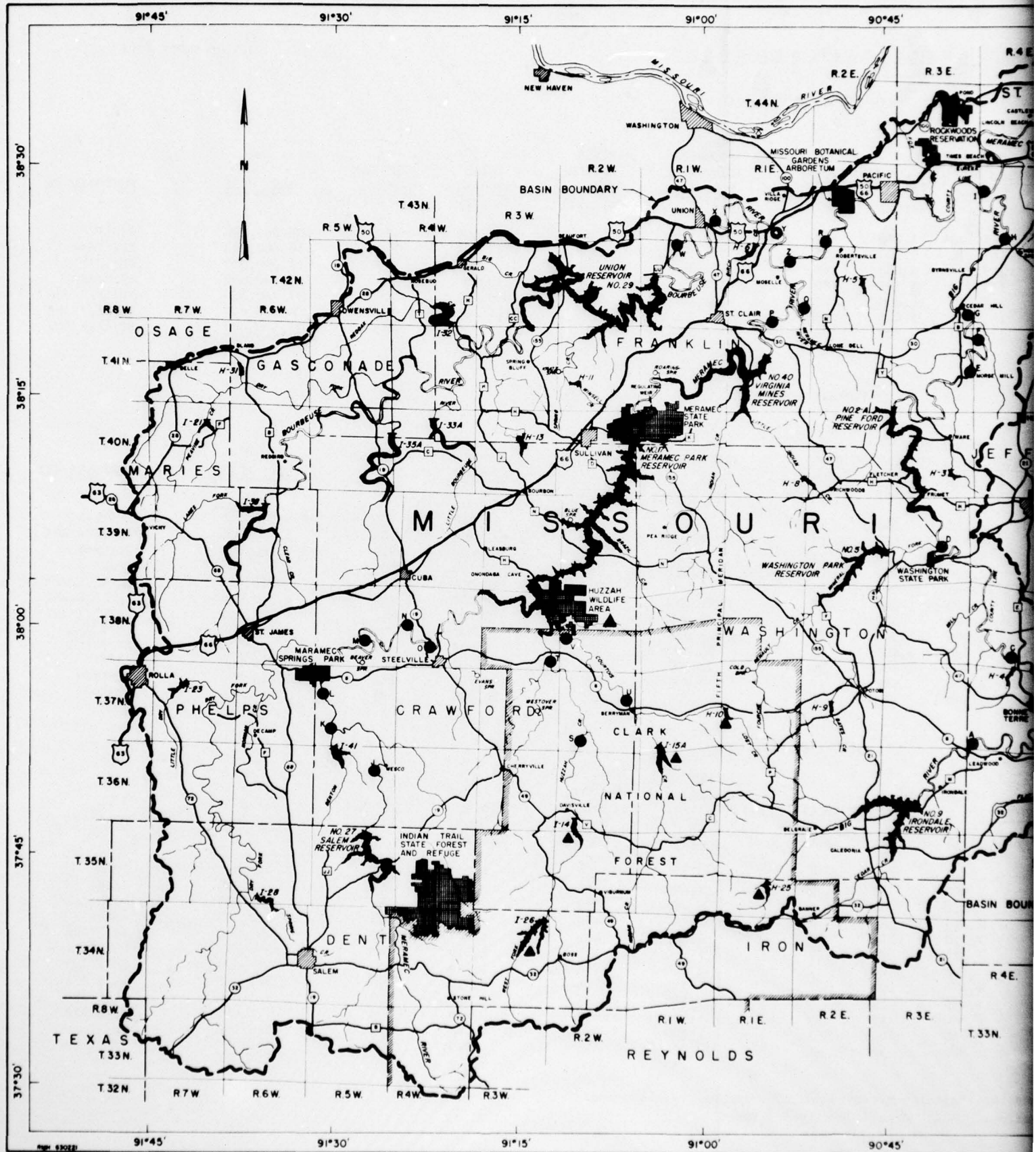
The need for publicly owned lands downstream of the proposed reservoir system is to provide river and land access to fishermen without trespassing on private lands. The reservoir system is designed to maintain sufficient stream flow and water quality so that the attractiveness of downstream river fishing will be enhanced. All 26 angler-use sites recommended by the U. S. Fish and Wildlife Service are economically justified. It is considered that there would be immediate need only for those which are below the reservoirs to be recommended for authorization at this time.

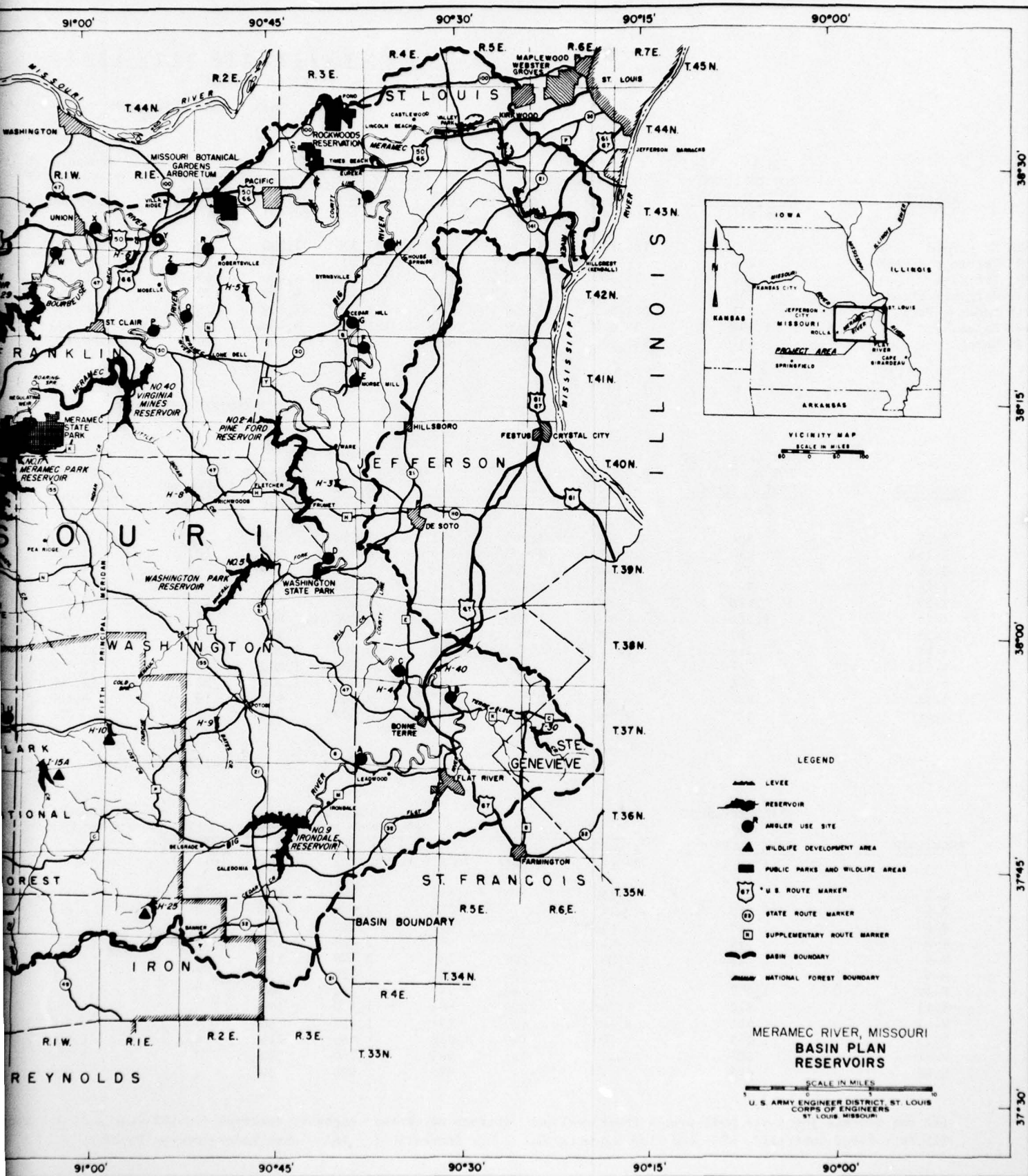
LOCAL PROTECTION PROJECTS

The nine local flood protection projects included in the Basin Plan are shown on Attachment 2. Six of these are economically justified at the present time. These are: Area 4, Starling Airport; Area 5, Butler Lakes; Area 8,

West Watson Road; Area 9, Weiss Airport; Area 11, Valley Park; and Area 12, Peerless Park. These local protection projects (shown on Atch. 2) are designed to protect against Mississippi River backwater effects and against overbank flows of the Meramec River which might result from rainfall runoff from the uncontrolled drainage area below the reservoir system. Planning and construction of these local protection projects should proceed concurrent with the planning and construction for the reservoir system.

6. Future Developments. The Basin Plan for the Meramec River Basin is flexible and provides for development as additional water resources needs become justified in the future. The construction schedules of these future developments can be adjusted to conform to the actual growth pattern and needs of the basin. However, current studies indicate that all of the reservoir sites of the Basin Plan need to be protected now, in some measure, from encroachment in order to insure future development that will meet the still growing needs of the basin.





VICINITY MAP
SCALE IN MILES
0 50 100

RESERVOIR DATA SHEET

MAIN STREAM RESERVOIRS

RESERVOIR	SPILLWAY CREST TOP OF FLOOD CONTROL POOL (m. s. l.)	FLOOD CONTROL POOL		NORMAL POOL (BOTTOM OF FLOOD CONTROL POOL)				NET STORAGE JOINT-USE POOL (1) (ac-ft)
		STORAGE (ac-ft)	AREA (acres)	ELEV. (m. s. l.)	STORAGE (ac-ft)	AREA (acres)	SHORELINE (miles)	
#2A Pine Ford	595	196,700	8,100	561	88,300	3,700	60	76,300
#5 Washington Park	706	---	---	706	147,200	3,500	55	141,600
#9 Irondale	860	23,900	5,100	855	137,100	4,600	65	131,300
#40 Virginia Mines	556	---	---	556	110,300	5,200	70	101,300
#17 Meramec Park	701	581,600	22,500	667	418,400	12,600	175	400,200
#27 Salem	1,008	30,000	3,900	1,000	131,200	3,400	50	125,200
#29 Union	651	355,600	13,800	616	172,400	6,600	100	160,500

TRIBUTARY RESERVOIRS

RESERVOIR	SPILLWAY CREST TOP OF FLOOD CONTROL POOL (m. s. l.)	FLOOD CONTROL POOL		NORMAL POOL (BOTTOM OF FLOOD CONTROL POOL)				NET STORAGE JOINT-USE POOL (ac-ft)
		STORAGE (ac-ft)	AREA (acres)	ELEV. (m. s. l.)	STORAGE (ac-ft)	AREA (acres)	SHORELINE (miles)	
I-14	881	27,500	1,200	847	7,900	500	9	3,900
I-15A	834	29,600	1,500	806	8,400	600	10	3,600
I-21	904	6,300	700	887	2,300	200	4	700
I-23	941	---	---	941	12,700	700	15	10,600
I-26	1,026	4,600	700	1,019	21,400	600	15	19,600
I-28	1,112	11,800	1,500	1,101	14,200	900	18	11,700
I-30	790	2,700	400	782	4,400	300	14	2,900
I-32	718	---	---	718	26,000	1,300	26	23,000
I-33A	777	---	---	777	26,000	1,200	22	23,300
I-35A	786	---	---	786	26,000	1,300	20	22,700
I-38	857	29,600	2,500	837	9,400	900	15	4,700
I-41	874	7,700	500	853	2,600	250	6	700

HEADWATER RESERVOIRS

RESERVOIR	SPILLWAY CREST TOP OF FLOOD CONTROL POOL (m. s. l.)	FLOOD CONTROL POOL		NORMAL POOL (BOTTOM OF FLOOD CONTROL POOL)				NET STORAGE JOINT-USE POOL (ac-ft)
		STORAGE (ac-ft)	AREA (acres)	ELEV. (m. s. l.)	STORAGE (ac-ft)	AREA (acres)	SHORELINE (miles)	
H-3	629	1,850	210	618	900	110	3	230
H-4	673	---	---	673	2,080	90	2	1,430
H-5	549	640	80	537	310	40	2	80
H-6	536	---	---	536	2,760	180	4	2,030
H-8	717	2,840	290	706	3,120	210	14	2,080
H-9	948	1,430	150	935	810	70	2	190
H-10	1,007	670	90	997	570	60	2	140
H-11	818	1,880	200	806	1,170	100	3	350
H-13	811	4,170	400	794	1,410	50	4	350
H-25	1,043	700	140	1,038	1,960	115	4	1,090
H-31	885	---	---	885	1,760	160	3	1,250
H-40	675	---	---	675	900	50	2	520

(1) Net storage joint-use pool equals the normal pool storage minus that capacity reserved for 100-year sediment storage.

(2) FC - Flood Control; LF - Low Flow Augmentation; R - Recreation; ARA - Area Redevelopment Benefits

O I R D A T A S H E E T

4 December 1963

STREAM RESERVOIRS

OL POOL) SHORELINE (miles)	NET STORAGE JOINT-USE POOL (1) (ac-ft)	RIVER BOTTOM ELEV. (m. s. l.)	TOTAL STORAGE (ac-ft)	TOP DAM ELEV. (m. s. l.)	EST. COST	PURPOSES (2)
60	76,300	496	285,000	637	\$24,200,000	FC/LF/R
55	141,600	590	147,200	737	16,800,000	LF/R/ARA
65	131,300	760	161,000	987	13,500,000	FC/LF/R
70	101,300	500	110,300	592	18,400,000	LF/R/ARA
175	400,200	566	1,000,000	736	37,700,000	FC/LF/R/ARA
50	125,200	894	161,200	1,039	14,900,000	FC/LF/R/ARA
100	160,500	531	528,000	682	25,600,000	FC/LF/R/ARA
					<u>\$151,100,000</u>	

IBUTARY RESERVOIRS

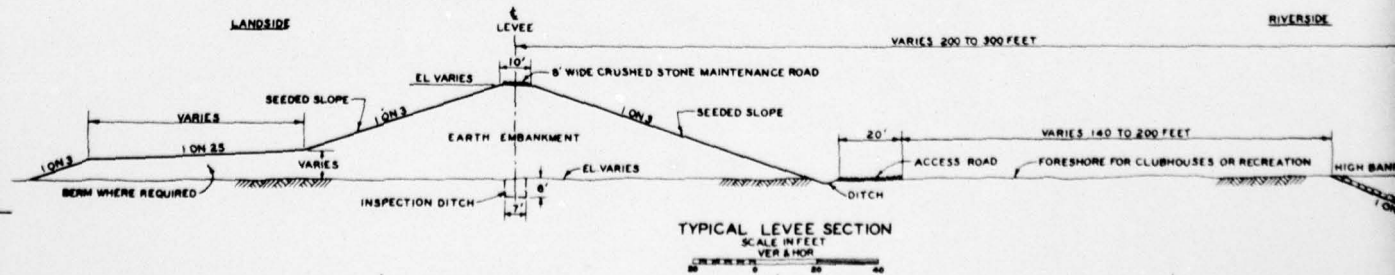
OL POOL) SHORELINE (miles)	NET STORAGE JOINT-USE POOL (ac-ft)	RIVER BOTTOM ELEV. (m. s. l.)	TOTAL STORAGE (ac-ft)	TOP DAM ELEV. (m. s. l.)	EST. COST	PURPOSES (2)
9	3,900	805	35,400	916	\$ 6,640,000	FC/LF/R
10	3,600	765	38,000	867	6,950,000	FC/LF/R/ARA
4	700	865	8,600	916	3,440,000	FC/LF/R
15	10,600	885	12,700	965	4,870,000	LF/R
15	19,600	925	26,000	1,046	4,790,000	FC/LF/R/ARA
18	11,700	1,045	26,000	1,124	4,780,000	FC/LF/R/ARA
14	2,900	745	7,100	811	3,540,000	FC/LF/R/ARA
26	23,000	665	26,000	728	4,410,000	LF/R/ARA
22	23,300	705	26,000	797	5,150,000	LF/R/ARA
20	22,700	735	26,000	809	5,200,000	LF/R
15	4,700	805	39,000	880	5,610,000	FC/LF/R
6	700	825	10,300	898	3,680,000	FC/LF/R
					<u>\$59,060,000</u>	

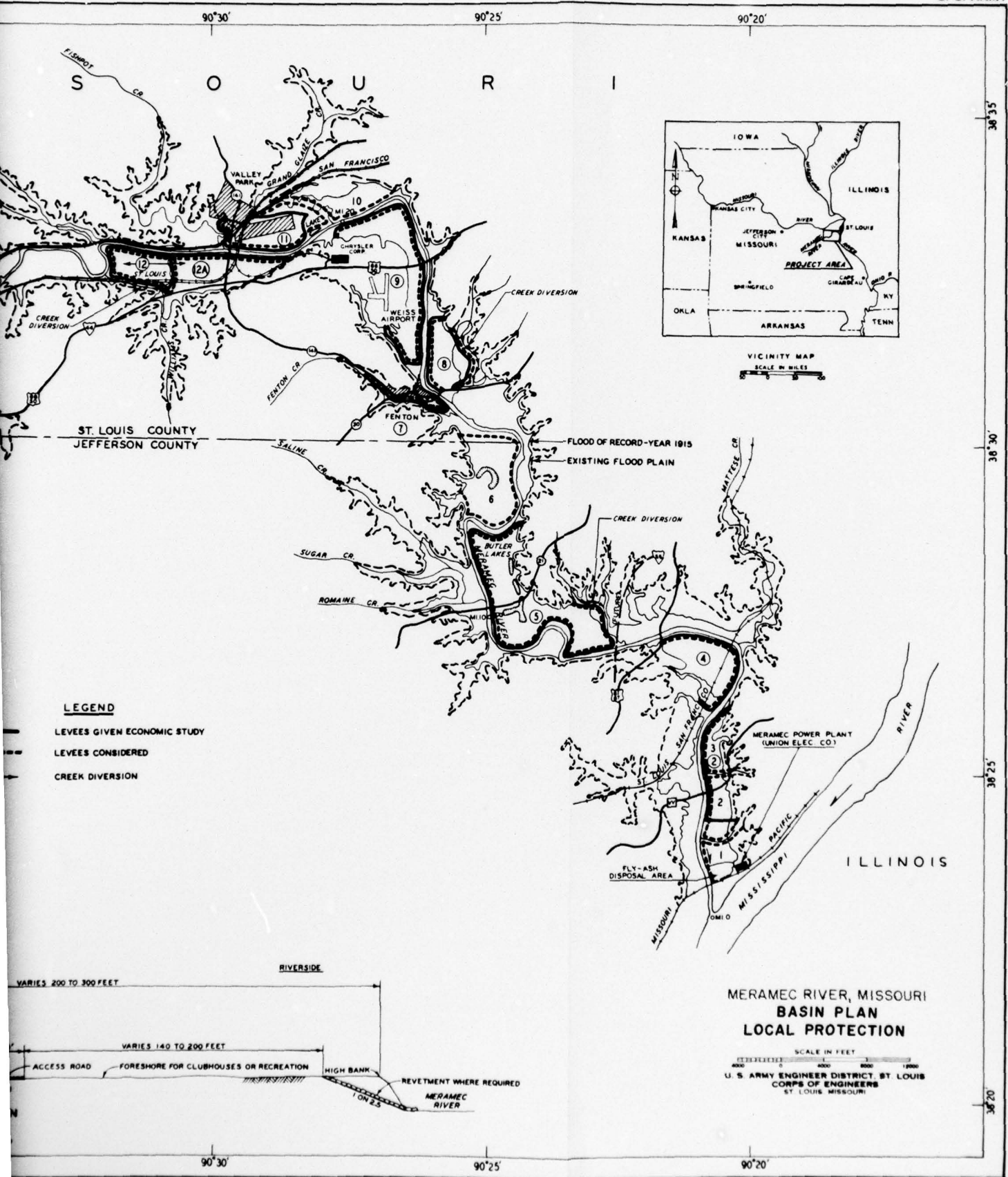
HEADWATER RESERVOIRS

OL POOL) SHORELINE (miles)	NET STORAGE JOINT-USE POOL (ac-ft)	RIVER BOTTOM ELEV. (m. s. l.)	TOTAL STORAGE (ac-ft)	TOP DAM ELEV. (m. s. l.)	EST. COST	PURPOSES (2)
3	230	592	2,750	635	\$ 419,000	FC/R
2	1,430	617	2,080	683	740,000	R/ARA
2	80	512	950	555	362,000	FC/R/ARA
4	2,030	492	2,760	543	830,000	R/ARA
14	2,080	664	5,960	723	1,020,000	FC/R/ARA
2	190	908	2,240	955	566,000	FC/R/ARA
2	140	968	1,240	1,015	516,000	FC/R/ARA
3	350	776	3,050	824	379,000	FC/R/ARA
4	350	764	5,580	817	761,000	FC/R/ARA
4	1,090	988	2,660	1,054	778,000	FC/R/ARA
3	1,250	850	1,760	895	530,000	R
2	520	632	900	685	504,000	R/ARA
					<u>\$7,405,000</u>	

ed for 100-year sediment storage.
evelopment Benefits

2





MERAMEC RIVER BASIN
DIGEST OF PUBLIC HEARING HELD AT
ST. CLAIR, MISSOURI
18 DECEMBER 1963

A public hearing was held by the District Engineer, U. S. Army Engineer District, St. Louis, on 18 December 1963, at St. Clair, Missouri, to obtain the views of local interests in regard to the findings of the Meramec River, Missouri, Comprehensive Basin Study. A synopsis of these findings was distributed to all of those receiving the "Notice of Public Hearing" on 4 December 1963.

The meeting convened at 9:30 a.m. Approximately 1,000 people were present, representing Federal and State agencies, county and municipal organizations, planning bodies, numerous individual land-owners, and other interested participants.

The District Engineer reviewed the "Synopsis of Findings" and summarized the elements of the basin plan which were presented therein. The proposed improvements were depicted on a large map of the Meramec Basin.

The first statement was made by Congressman Clarence Cannon, representative from the 9th Congressional District, which includes Franklin and Gasconade Counties, major portions of which lie within the Meramec Basin. Mr. Cannon expressed wholehearted support of the basin plan and further stated that he had discussed his views with Congressmen Ichord, Curtis, and Karsten, who requested that he "assure them that we will cooperate with them in any way we can".

The District Engineer read a letter which had been received from Senator Stuart Symington, which stated in part:

"I have not had an opportunity to study in detail the plan which the Corps of Engineers will propose on December 18th. Based on preliminary reports, however, it would appear the plan you will present offers a sound way to meet the present and future water needs of the Meramec River Basin, and at the same time will help assure economic growth and prosperity for this section of our country."

EXHIBIT E

Mr. Clifford Summers, representing the Governor of Missouri, stated that an Advisory Committee appointed by the Governor and representing the various State agencies having a pertinent interest in the development of the Meramec Basin pledged its support of the comprehensive development of the Meramec Basin. This Committee had worked with the Corps in the development of a plan of improvement and believes that the resulting plan as proposed will fulfill what the Committee considers should be accomplished in river basin planning.

Colonel R. E. Smyser, Jr., Executive Director, Bi-State Development Agency, created by the States of Missouri and Illinois, read a statement recording the complete support of the Agency for the proposed plans for comprehensive development of the Meramec River.

Mr. Leo Politte, Chairman of the Meramec Basin Corporation Board, read a statement of the Board, comprised of 73 members, stating that the planning reflected by the "Synopsis of Findings" had been established in a sound and purposeful manner.

Judge Herbert Moss, presiding Judge of the Jefferson County Court at Hillsboro, read a resolution of the County Court which recorded it as being in favor of the basin plan and, in particular, that portion of the plan pertaining to the Big River and the Starling Airport area. He further affirmed the readiness of the County Government to accept responsibility and to respond to proposals in the plan which will affect Jefferson County's own view of its future development.

Mr. D. Reid Ross, Director of the St. Louis County Business and Industrial Development Commission, read a statement, which had been adopted by the Commission with the concurrence of the St. Louis County Supervisor and the Director of the St. Louis County Planning Commission, supporting the plan of the Corps of Engineers in bringing water recreation facilities to the Meramec Basin and the St. Louis area.

Mayors and representatives of the towns of St. Clair, Steelville, Sullivan, Union, Valley Park, Irondale, Bourbon, Times Beach, DeSoto, Eureka, Salem, Cuba, Pacific, and Fenton read statements indorsing the plan.

Mr. C. B. Briscoe, President of the Board of Public Service, City of St. Louis, expressed the interest of the City in the economic development of the basin.

Mr. Warren E. Hearnese, Secretary of the State of Missouri, spoke in favor of enactment of legislation which would insure Missouri's proper representation in the development of the Meramec River Basin and pledged his support and cooperation.

Mr. John F. Hallett, representing the St. Louis Chamber of Commerce, referred to an earlier report of the Chamber prepared in 1957, and stated that the plan presented today by the Corps of Engineers is considered to be in perfect harmony with the Chamber's policies.

Mr. John I. Rollings, President of the Missouri State Labor Council AFL-CIO, which is comprised of more than 1,500 local unions and over 450,000 members, stated that the "Synopsis of Findings" fulfills generally the basic thoughts expressed earlier in a resolution by the Council, and that the proposed Corps of Engineers plan embodies a well developed program of water use, flood control, soil conservation, and recreation.

Mr. Leonard Neef, representing the United Sportsmen's League, Inc., of St. Louis, comprised of 13 individual conservation and sportsmen organizations with a combined membership of approximately 10,000, recommended that the comprehensive basin plan for the Meramec Basin proposed by the Corps be approved at the earliest possible date to provide the best and urgently needed uses of water and land resources.

Mr. Charles H. Kroll, Chairman of the Board of Directors of the Anglers of Missouri, said: "We are hoping that this plan would come to an immediate conclusion and proceed and make fishing and recreation the number one industry in the State of Missouri."

The St. Louis Industrial Recreation Council, representing approximately 80,000 employees of 21 leading St. Louis industries, through its representative, Mr. Ross Stones, indorsed the current plan of the Corps of Engineers. Other organizations indorsing the plan were represented by officials of local unions, Chambers of Commerce, and various organizations.

Individuals supporting the proposed plan of improvement stressed the importance of providing a better economic environment for the youth of the area, citing the situation of high school graduates being unable to find commensurate employment at home. These individuals expressed their belief that the cure for this situation was to develop

the water resources of the basin to provide favorable employment and recreation opportunities. Other individuals cited the need for flood control, water supply, and pollution abatement.

Mr. Richard Horner, representing the Meramec Rivers Association, stated: "It is the view of the Meramec Rivers Association that the so-called 'plan of improvements' is far too large in scope, extravagant in cost, destructive of natural assets in the form of our native rivers, and not properly receptive to the primary need of the basin, which is the development of mass water recreation facilities close to the center of population, which at the same time preserves the upper valley in its natural condition." He further charged that the findings of the Corps of Engineers are not in accordance with the outline provided in the Washington University Ullman Report.

Many landowners who made their living from farming in the area were opposed to any reservoir developments, citing the loss of productive land and their opposition to being displaced.

Of the 54 oral statements, 42 were definitely in favor of the plan presented by the Corps of Engineers, 6 were against the plan, 4 favored alternate developments closer to St. Louis which would leave the clear-flowing streams undisturbed, and 2 made statements for the record which were considered to be of a general nature. Of the 94 written statements received, 73 were considered to be for the plan, 14 against, and 7 of a general nature.

The meeting was adjourned at approximately 5:40 p.m.